

Compressed Air

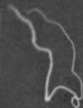
Magazine

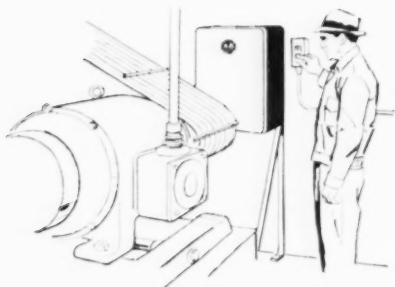


SEPTEMBER 1959

IN THIS ISSUE:

NEW DRY-AIR SOURCE
HOUSES FROM A FACTORY
DECENTRALIZED AIR SUPPLY
AIR-PLACED CONCRETE
INDEX AND COVER STORY, PAGE 3





WHEN REDUCED VOLTAGE STARTING IS A MUST

Only Allen-Bradley
can provide all the answers

The Allen-Bradley line of reduced voltage starters makes possible a selection of the best starter, not only to meet the power company's requirements but also to provide the best starting conditions for the motor and the "load" that it drives.

The simple solenoid contactors in A-B reduced voltage starters have only ONE moving part—assuring millions of trouble free operations. And their double break, silver alloy contacts never need costly maintenance. Accurate, reliable overload relays protect motors against burnouts. Write for Publication 6088

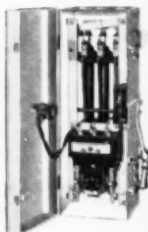


Bulletin 740

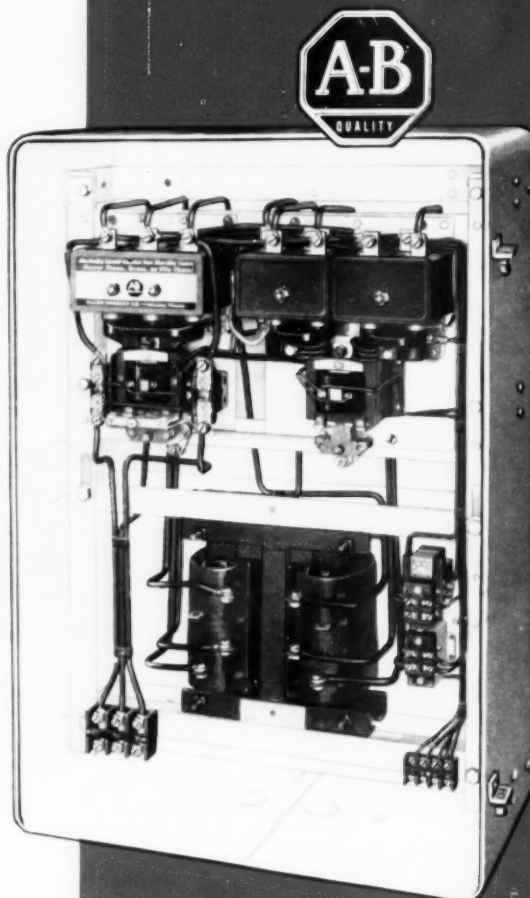
Graphite disc resistors are automatically inserted in series with the squirrel cage motor at starting, and they are automatically cut out after a pre-determined time. Turning a single screw on the starter frame adjusts the compression resistors exactly to motor and load conditions for velvet smooth acceleration. Ratings to 200 hp, 220-440-550 v.

Bulletin 640

Where remote control is not needed, these graphite compression disc resistor starters provide stepless acceleration of squirrel cage motors. Operated by hand lever, the smooth starting of the motor is under the control of the operator. No-voltage and dependable overload protection is provided. Ratings to 200 hp, 220-440-550 v.



Allen-Bradley Co., 212 W. Greenfield Ave., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.



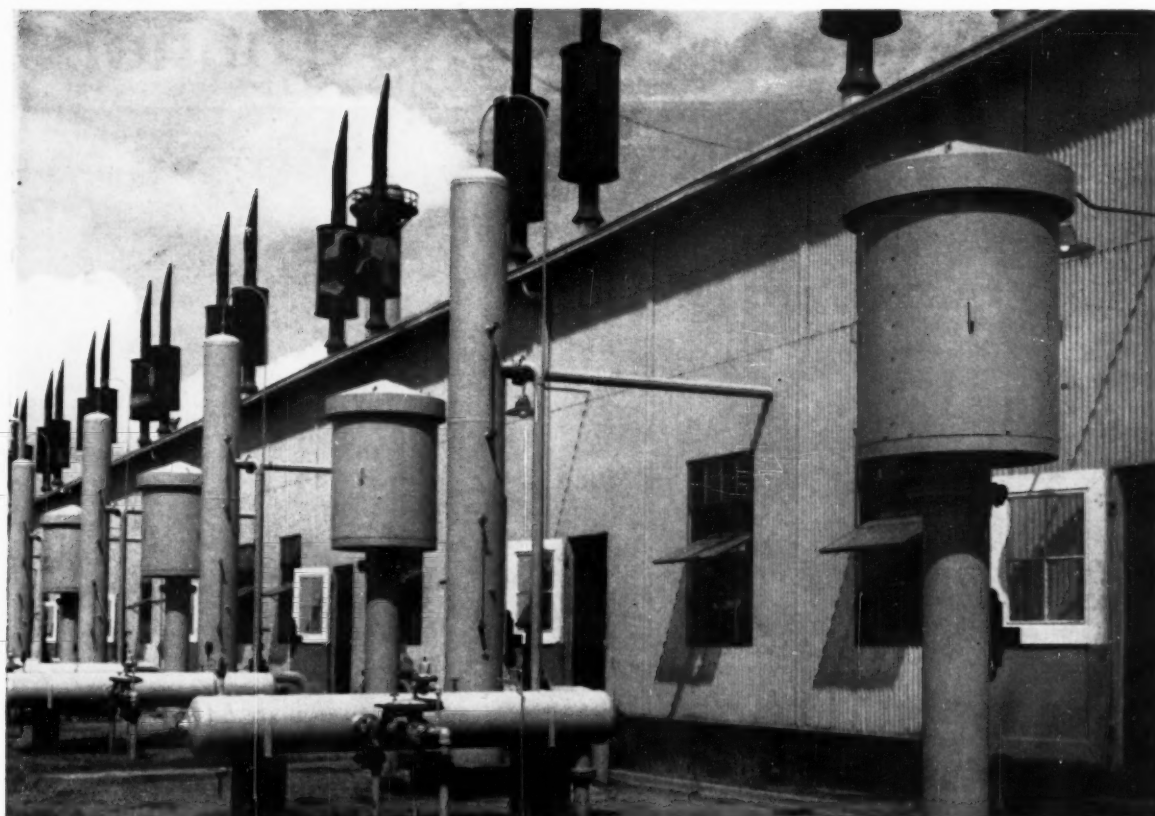
Bulletin 746

Automatic reduced voltage starter for squirrel cage motors that should not be started on full line voltage. It employs autotransformer connected in open delta to reduce line voltage during starting. Adjustable timing relay controls starting period. Taps are provided on the autotransformer to adjust the starting voltage applied to the motor. Ratings to 300 hp, 220 v; 600 hp, 440-550 v.

ALLEN- BRADLEY

Member of NEMA

Quality Motor Control



Partial view of a Falfurrias, Tex., gas plant showing four of eight Staynew air-intake filters that are effecting spectacular economies in maintenance costs for La Gloria Oil and Gas Co.

Filters Function Four Full Years Without Maintenance

In 1952 the Falfurrias, Tex., gas plant of La Gloria Oil and Gas Co. substituted two Staynew air-intake filters for conventional oil-bath filters on two gas-engine-driven, natural-gas compressors.

Two and a half years later the pressure drop through the Staynew filters had increased only to where it equalled the pressure drop of an oil-bath filter *immediately after an oil change*.

Air resistance was not yet enough to warrant cleaning. Therefore, La Gloria left the filters alone for another 19 months before deciding on an overhaul.

Oil-bath filters by comparison had required an oil change every 10 months, each change calling for 60 gallons of oil and high labor costs.

As evidence of its satisfaction with Staynew filters, the company installed four more in 1954, another pair in 1955, and an additional three in 1956 to replace the last of the oil-bath filters.

The efficiency of Dollinger Staynew filters actually increases with use. So why buy filters that require rigid maintenance schedules? Let a Dollinger representative show you how to save time and money with Staynew Intake Filters, or write for Bulletin 100. Dollinger Corporation, 7 Centre Park, Rochester 3, N. Y.



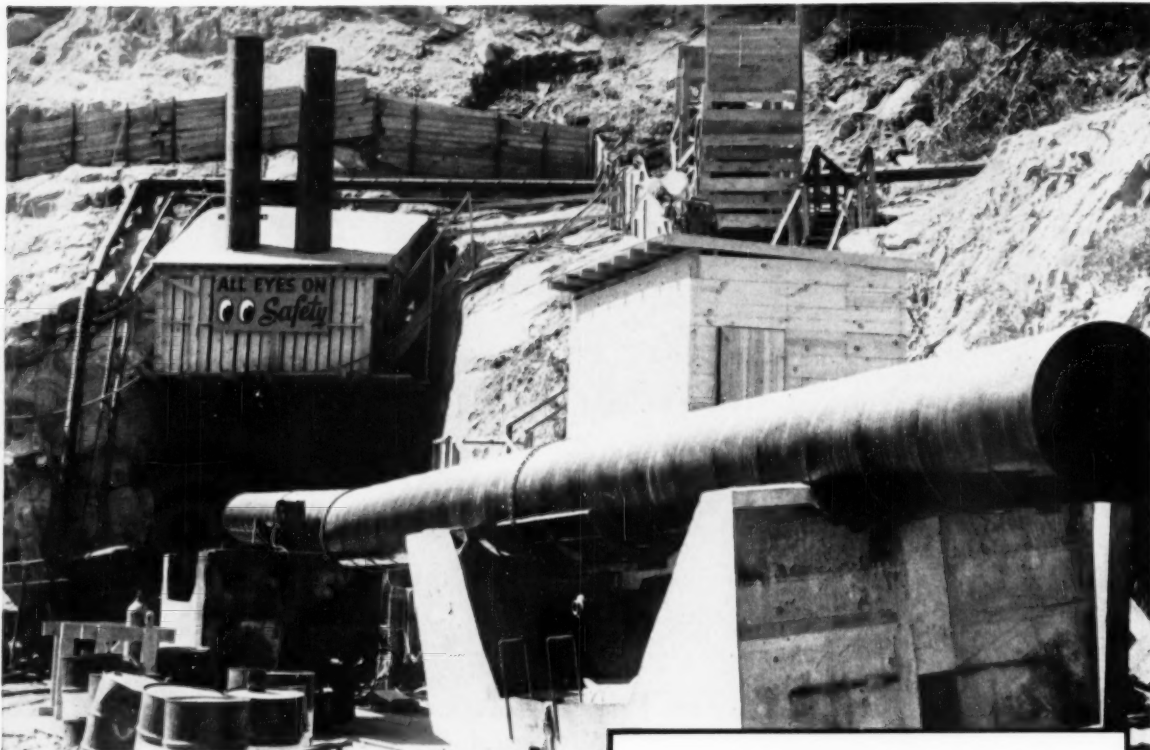
STAYNEW

DOLLINGER



LIQUID FILTERS • PIPE LINE FILTERS • INTAKE FILTERS • HYDRAULIC FILTERS • ELECTROSTATIC FILTERS • MIST COLLECTORS • DRY PANEL FILTERS • SPECIAL DESIGN FILTERS • VISCOUS PANEL FILTERS • LOW PRESSURE FILTERS • HIGH PRESSURE FILTERS • AUTOMATIC VENTILATION FILTERS • NATURAL GAS FILTERS • SILENCER FILTERS

PIPING SAFETY Into Tunnels

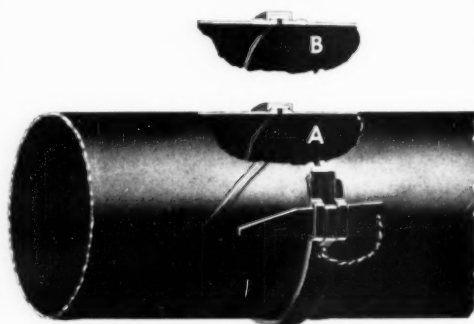


Speaking of safety, you can't go far underground without dependable pipe lines to bring in fresh air and exhaust smoke, gases and fumes.

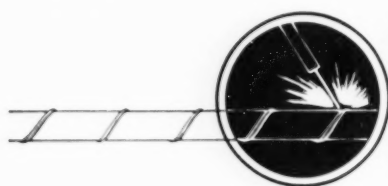
NAYLOR Spiralweld pipe and Wedgelock couplings provide the ideal combination for ventilating lines in tunnel operations. The pipe is light in weight and easy to handle and install. The spiral-lockseam construction builds in the extra strength needed for push-pull service. And the NAYLOR Wedgelock coupling insures faster installation because connections can be made with only one side of the pipe in the open.

Whether you need pipe for handling ventilation, water or dredging service, it will pay you to consider the advantages of this NAYLOR combination.

Write for Bulletin No. 59



The NAYLOR LOW-PRESSURE WEDGELOCK coupling provides a fast, positive connection. Ideal for ventilating service because it saves space and permits the line to hug the wall. NAYLOR pipe is furnished with (A) accurately-sized shoulder ends or (B) with grooved ends for this advanced-type coupling.



NAYLOR PIPE *Company*

1245 East 92nd Street, Chicago 19, Illinois

Eastern U. S. and Foreign Sales Office: 60 East 42nd Street, New York 17, N. Y.

Compressed Air Magazine

Founded 1896

VOLUME 64 NUMBER 9

September 1959

R. J. Nemmers, *Editor*
S. M. Parkhill, *Associate Editor*
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C. H. Vivian, *Contributing Editor*
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243 Upper Thames St., London, E.C. 4.



ON THE COVER

Groundbreaking ceremonies for the construction of the Narrows-Verrazano bridge between Staten Island and Brooklyn, N.Y., were held on August 13. The \$320 million project, when completed in 1965 will provide the first direct connection between Staten Island and the other four New York City boroughs since the Island was settled 298 years ago. Not only will its center span be the longest suspension span in the world, exceeding that of the Golden Gate Bridge by 60 feet, but it will be the highest—277 feet above mean sea water datum. Shown on the cover is an artist's sketch of a portion of the double deck structure which, in its first year of operation, is expected to carry some 16.3 million vehicles. By 1981 it is expected that traffic will total 48 million cars and trucks annually.

FEATURE ARTICLES

Page 10 Low Dew-Point Compressed Air—*R. J. Nemmers*

A unique desiccant-type dehumidifier for air and other gases, that does not rely on heat for regeneration, is now available. It can help many industries in their quest for "dry" air.

14 Houses from a Factory—*G. R. Smith*

Presidential Homes, Inc., applies "components construction" to produce a diverse line of houses for rapid erection. Air power is an essential for maximum production and high standards.

18 A Portrait of an Air Plant—*S. M. Parkhill*

This second article of a 2-part series about Thompson Ramo Woolridge Inc., describes its Tapco Group. The colony system of production, and the decentralized air plants required for it, are explained.

22 Fort Pitt Tunnel

Pneumatically placed concrete is helping to push this project to an earlier-than-estimated completion. The tunnel and its companion bridge will speed travelers into and out of downtown Pittsburgh, Pa.

25 Relocating Two Routes at Rocky Reach—*Pat Thompson*

Problems of simultaneously moving a highway and a railroad were overcome by a carefully timed, precision blasting program.

27 Meat-Curing Process Aided by Compressed Air— *J. F. Krambule*

Pumping brine by air pressure results in consistently better hams.

30 Project: To Measure Density Drag

A 9-foot plastic sphere will be inflated 60 miles above the earth in this Arthur D. Little development.

DEPARTMENTS

- 28 This and That
- 31 Editorial—*Industrial Gases*
- 32 Saving With Air Power—*Application: Swift-Moving Air Solves Chip Problems*
- 34 Industrial Notes
- 51 Index to Advertisers

BPA

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HOW TO PICK A WINNER IN THE "OCTANE RACE"



Selecting the **RIGHT PUMP**
can increase the dependability and economy
of your new **DOWNSTREAM PROCESSING UNIT**

WHATEVER process you pick for upgrading motor fuel octane, its performance depends on **PUMPS!**

*Here are some facts
to help you choose wisely*

● **STANDARD PUMPS** save on initial investment and should be used where they can meet the exact requirements. Ingersoll-Rand makes the *most complete* line of centrifugal pumps available from any one source, and can supply standard units for practically any job—including many that would be "special" for other manufacturers.

● **SPECIAL PUMPS** and materials may be required for some downstream applications. If the right pump isn't to be found in the standard line, I-R can build it, with maximum utilization of standard parts and designs.

● **OPERATING COSTS** depend not only on published performance curves, but on *sustained* high efficiency. And I-R pumps have built their reputation on long-term efficiency, with running clearances that can be maintained for years without frequent replacement of parts.

● **INTERCHANGEABILITY** of parts between similar pump designs can materially reduce your spare parts inventory. The degree to which this has been achieved in each class of I-R pumps can be demonstrated with available interchangeability charts.

● **ENGINEERING SERVICE** by I-R pump specialists can help you every step of the way—from initial selection to installation and operation. There's no substitute for experience in engineered products, and when it comes to centrifugal pumps, Ingersoll-Rand's experience is second to none.

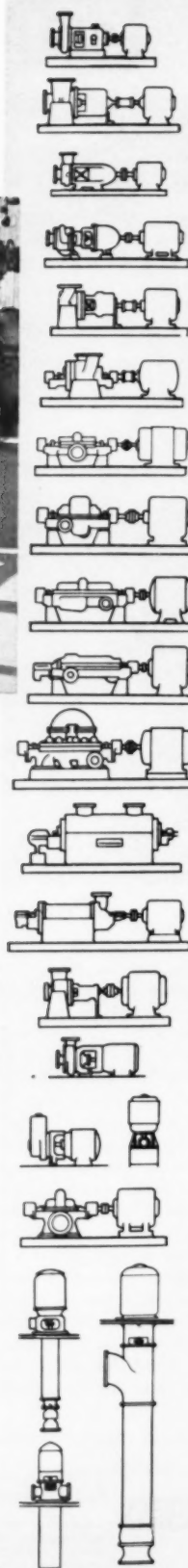


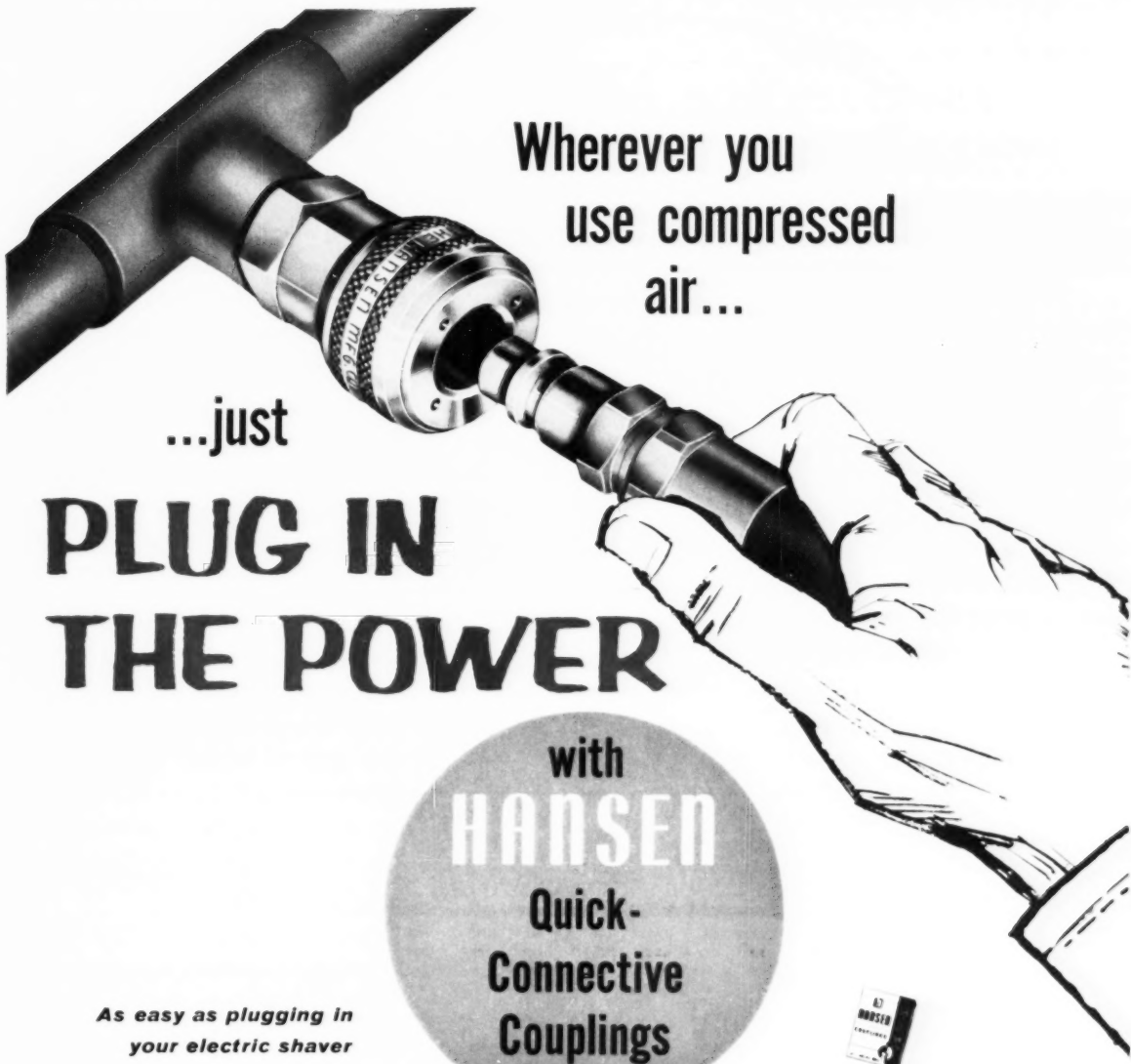
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Couplings

*As easy as plugging in
your electric shaver*

To connect the Coupling, just push the Plug into the Socket — with one hand. Flow is instantaneous. To disconnect, push back sleeve on Socket. Coupling disconnects with instant, automatic shut-off of air.

Write for Hansen Catalog

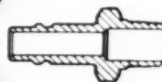
a ready reference when you want information on couplings in a hurry. Lists complete range of sizes of Hansen One-Way Shut-Off, Two-Way Shut-Off, and Straight-Through Couplings.



Blue section shows how Socket, when disconnected, automatically shuts off air by leak-proof seal of metal valve against rubber valve seat.

Quick
Connection
and
Disconnection

Instant
Automatic
Flow or
Shut-Off



**Quick-Connective
Fluid Line Couplings for**

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WATER • VACUUM • STEAM • OXYGEN
ACETYLENE • REFRIGERANTS • GASOLINE
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QUICK-CONNECTIVE FLUID LINE COUPLINGS

THE HANSEN

MANUFACTURING COMPANY

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CLEVELAND 35, OHIO

COMPARE THE NEW

EIMCO 123

FRONT END LOADER! CHECK THE

FACTS

NOT THE CLAIMS

	EIMCO 103	CAT D-4	CAT D-6	AC HD-6	AC HD-11	INT. TD-9	INT. TD-15	CASE 1000
Maximum Drawbar Pull, Pounds (zero track slippage)	33,600	10,700	19,000	15,485	21,980	13,240	23,750	24,000
Torque Converter	Yes	No	No	No	No	No	No	Yes
Master Clutch	No	Yes	Yes	Yes	Yes	Yes	Yes	No
Power shift transmission on all speeds, with oil-cooled metallic clutches that never need adjustment	Yes	No	No	No	No	No	No	No
Independently reversible track	Yes	No	No	No	No	No	No	Yes
Hydraulic track take-up	Yes	No	No	No	No	No	No	Yes
Heat-treated alloy steel grouser shoes, keyed to the track links	Yes	No	No	No	No	No	No	No
One-piece heat-treated alloy steel track rollers, tapered roller bearings	Yes	No	No	No	No	No	No	No
Equalizer bar of heavy duty heat-treated cast alloy steel, allowing full oscillation of crawler tracks with all attachments	Yes	No	No	No	No	No	No	No
Constantly running power take-off drives, front and rear, to standard SAE specs, with rear take-off not affected by track operation, and independent hydraulic pump drive allowing simultaneous use of hydraulic, winch and hoist accessories	Yes	No	No	No	No	No	No	No
Front operator's seat for full visibility	Yes	No	No	No	No	No	No	No
Ability to operate forward and backward on up to 90° slopes	Yes	No	No	No	No	No	No	No
Tractor guaranteed for one full year of single shift service	Yes	No	No	No	No	No	No	No

FOR PROOF OF

EIMCO 123

SUPERIORITY

FRONT END LOADERS

	EIMCO 123	CAT 955	CAT 977	AC HD5G	AC HD11G	INT. 9K3	INT. 15K3	CASE 1000
WEIGHT, POUNDS	25,000	22,470	34,915	19,600	32,000	19,985	33,235	21,800
ROCK BUCKET CU. YARDS	1 1/4	1.1	1.8	1 1/2	2 1/4	1 1/2	2 1/4	N.A.
ENGINE HP	100	70	100	72	111	71	115	100
TRACK GAUGE, INCHES	60	60	74	60	74	60	74	60
SHOE WIDTH, INCHES	17	15	18	13	16	15	18	16
LENGTH OF TRACK, INCHES	88	81 1/2	105 1/2	83 1/2	106 1/2	75	98 1/2	79
TRACK AREA, SQ. INCHES	3,000	2,450	3,814	2,180	3,410	2,250	3,546	2,530
GROUND PRESSURE, PSI	8.3	9.2	9.2	9.0	9.4	8.9	9.4	8.6
LIFT HEIGHT TO HINGE PIN, INCHES	144	128	144	120	139	125	144	134
DUMP HEIGHT, INCHES	115	100	114	95	114	102	113	101
DUMP REACH, INCHES	44	38 1/2	39	31	37	26	37	40
MAX. DUMP ANGLE, DEGREES	63	50	50	45	52	60	58	50
MAX. PUMP PRESSURE, PSI	1,200	1,450	1,450	1,000	1,300	1,500	1,750	1,450
PUMP GPM	75	43	52.5	39	72	N.A.	N.A.	50
LIFT TIME, SEC.	7.5	7.0	9.1	9.0	9.0	7.7	9.0	7.5
DUMP TIME, SEC.	3.0	4.0	5.0	4.0	4.0	N.A.	N.A.	1.6
GROUND CLEARANCE, INCHES	17	13 1/2	19 1/2	11 1/2	13 1/2	9	10	16

N.A. — not available

Information is from manufacturer's data and other sources believed to be reliable, but cannot be guaranteed.

IT'S A FACT . . . not a claim . . . that here is a MODERN line of tractors that makes all other crawler-tractors old-fashioned!

Other exclusive features includes Unitized "Stress Flow" Construction, for far greater strength and rigidity; Self-cleaning Air Cleaner that completely eliminates ordinary routine cleaner maintenance and others, far too numerous to list here. Write for details and specifications on all the advanced engineering features of the modern Eimco 103 line of crawler tractors.

AVAILABLE IN FOLLOWING MODELS:

- 103 — TRACTOR AND DOZER
- 123 — FRONT END LOADER
- 133 — STEEL MILL FEL
- 143 — LOG LOADER

"ADVANCED ENGINEERING AND QUALITY CRAFTSMANSHIP SINCE 1884"

THE EIMCO CORPORATION

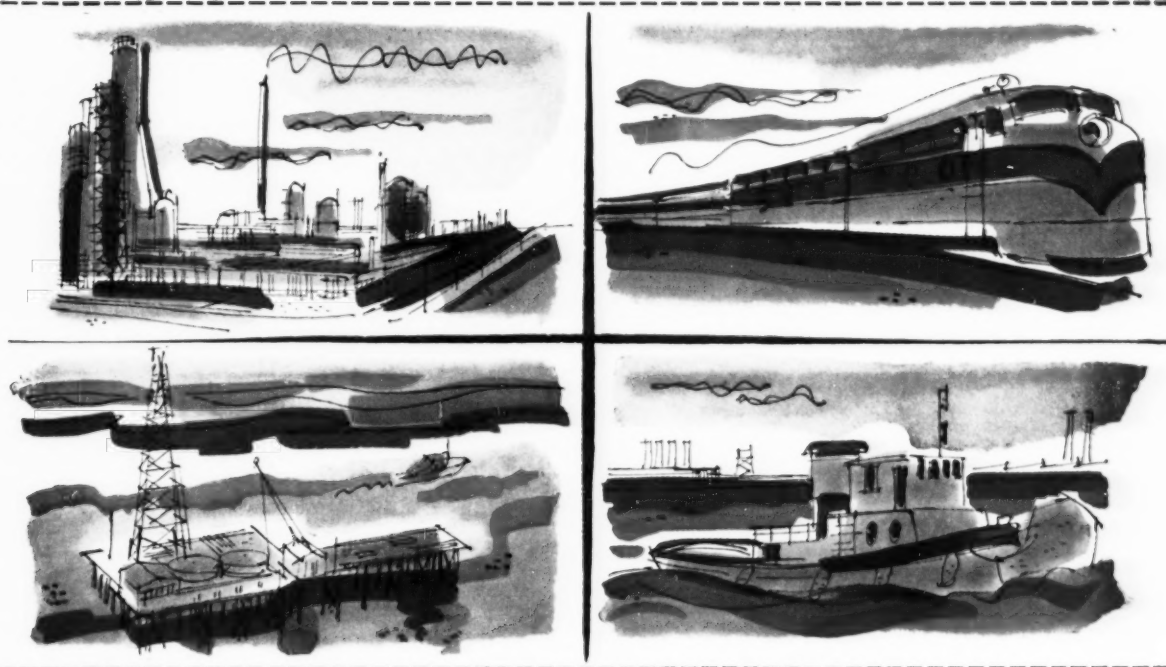


TRACTOR LOADER DIVISION

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EXPORT OFFICE: 51 - 52 SOUTH STREET, NEW YORK, N. Y.
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Where profit depends on keeping equipment in service, engineers recognize the importance of ring performance. That is why Koppers Piston Rings go into the finest engines in the world . . . why they are selected for replacement when better performance is demanded.

Since the first diesel engine, Koppers has produced piston rings of predictable performance in a complete range of materials and a wide selection of types and sizes. If you have a ring problem, Koppers can offer you the benefit of their experience. Write to: KOPPERS COMPANY, INC., Piston and Sealing Ring Department, 4109 Hamburg Street, Baltimore 3, Maryland.

Send now for Koppers recommended Piston Ring Set-Ups applicable to the engines which you operate.



PISTON AND SEALING RINGS

Engineered Products Sold with Service



Bethlehem wire rope along the Niagara. One of the country's busiest construction jobs is the Niagara Power Project now in full swing near the famous Falls. Being built under the direction of the Power Authority of the State of New York, it will harness the maximum potential on the American side of the Niagara River. Bethlehem wire rope is in constant use at many locations on the Niagara Power Project. Lifting a variety of heavy loads, and moving thousands of tons of earth and rock, it is providing the same dependable service as on less spectacular construction jobs throughout the nation.

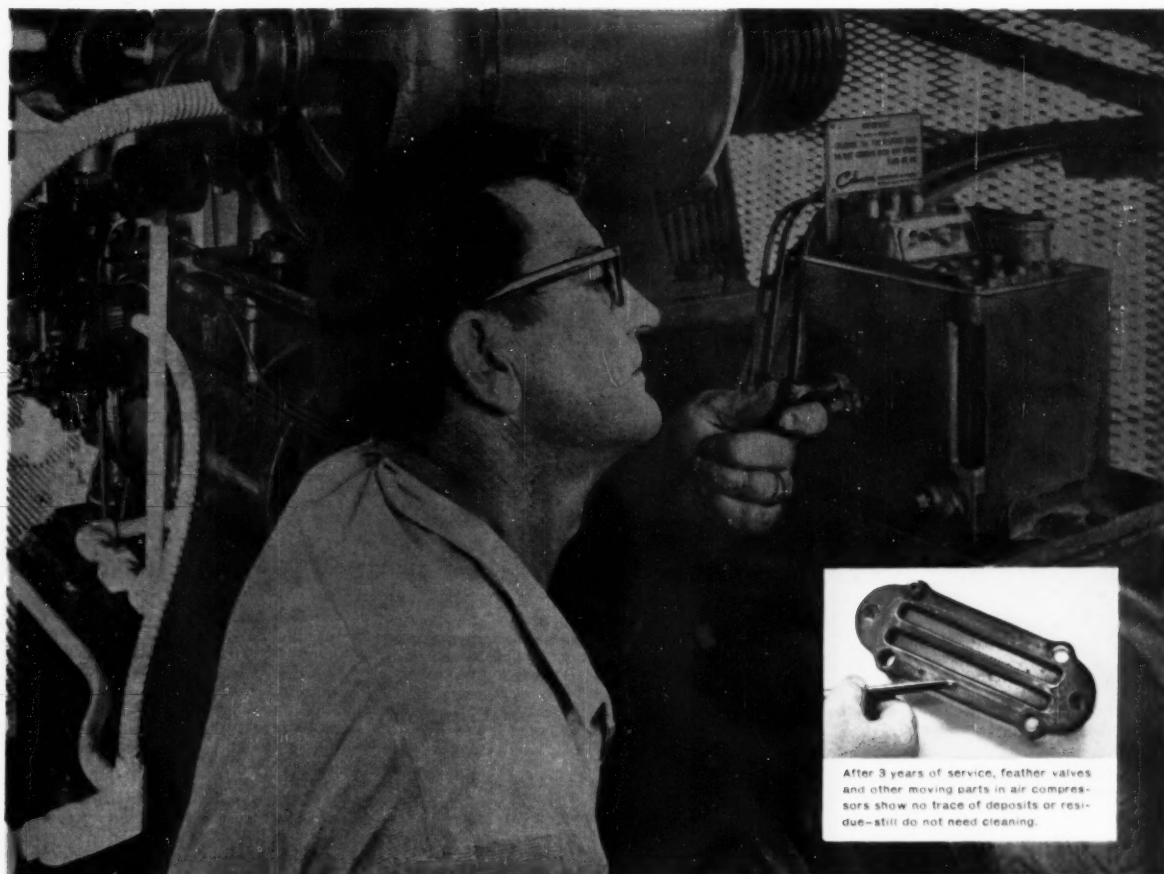
Upon completion, this project will have an installed capacity greater than Grand Coulee Dam, currently the country's largest hydroelectric development. A new intake gate structure above the Falls will divert river water through four miles of underground conduits and one mile of open canal to the main 1,950,000 kw power plant. In addition, a pump-generating plant will produce an additional 240,000 kw during periods of peak demands. Treaty restrictions limit the amount of water which can be diverted from the river for power purposes, assuring that the grandeur of the Falls will in no way be diminished for tourists.

Bethlehem Steel Company, Bethlehem, Pa. Export Distributor: Bethlehem Steel Export Corporation

Mill depots and distributors from coast to coast stock Bethlehem wire rope

BETHLEHEM STEEL





After 3 years of service, feather valves and other moving parts in air compressors show no trace of deposits or residue—still do not need cleaning.

"Cellulubes eliminate fires and explosions ... keep compressor parts clean"

says MR. T. E. DANIEL, Foreman, Cypress Compressor Station
Trunkline Gas Company, Cypress, Texas

"Since using Cellulube 220 in our air compressors we have never experienced or had any indication of fire or explosion in our compressed air systems," continues Mr. Daniel.


Installed at Trunkline's Cypress Compressor Station when it opened three years ago, Cellulubes thus provide an authoritative 7800-hour operating record that indicates not only efficient and far safer operation, but substantial savings as well. Mr. R. C. Carter, Trunkline's Compressor Department Superintendent, describes them thus:

"First and most important, of course, is the elimination of any risk to our personnel—from fire, explosion, or fragmentation. Secondly, we save on heavy equipment replacement costs, and

thirdly, down-time losses.

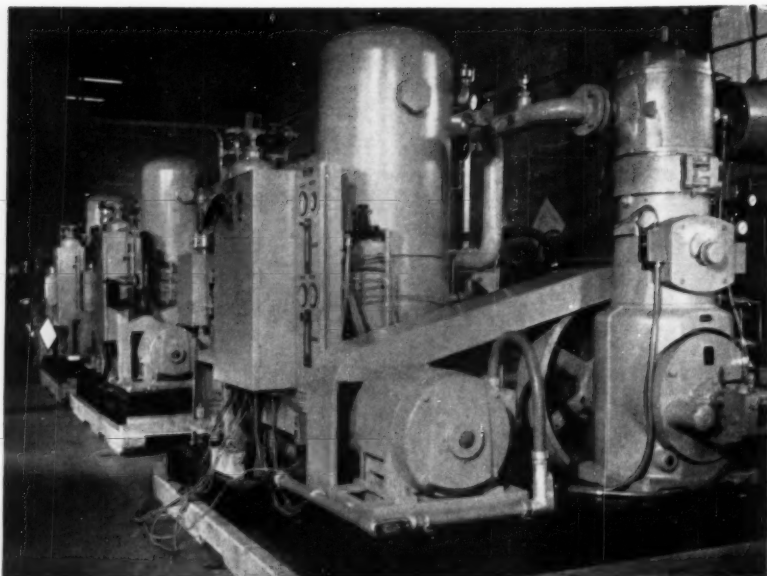
"A major savings is in preventive maintenance. Formerly, we completely disassembled and cleaned air compressors every six months. Cellulubes keep machinery so clean that this interval has been indefinitely extended, and so far we've saved at least 60 man-hours. Finally, Cellulubes never get 'dirty,' nor do they burn away by friction or compression."

Cellulubes . . . the *safe* lubricants and hydraulic fluids . . . are available in six controlled viscosities. If you'd like a sample for evaluation, please let us know the application involved. Celanese Corporation of America, Chemical Division, Dept. 596-S 180 Madison Avenue, New York 16, N. Y. Celanese® Cellulube®

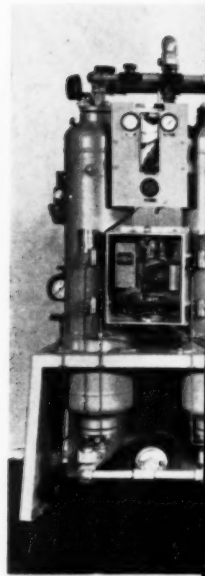
Cellulubes...  **Celanese**
CHEMICALS

fire-resistant functional fluids

Canadian Affiliate: Canadian Chemical Co., Limited, Montreal, Toronto and Vancouver • Export Sales: Amcel Co., Inc., and Pan Amcel Co., Inc., 180 Madison Avenue, New York 16, N. Y.



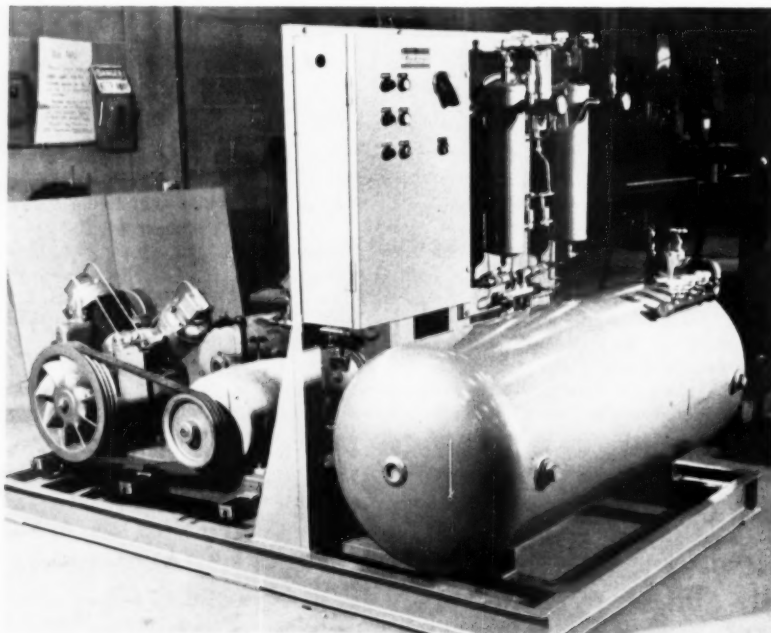
Shown above are three packaged drier-compressor units ready for shipment from Trinity Equipment's Cortland, N. Y., plant. Destined for a radar warning system, these units are designed to deliver 100 scfm at 10 psig and dew point below minus 65°F. Although utilizing a standard lubricated machine, oil vapor on the discharge side of the Heat-Les Dryer is guaranteed at less than 1 ppm. The compressor is an Ingersoll-Rand Class ESV unit with a 8x7-inch cylinder and is driven by a General Electric 30-hp motor. The compressor is rated at 130 scfm at 100 psig. Low pressure take-off's from the storage tank will furnish dry air to pressurize coaxial cables and wave guides.

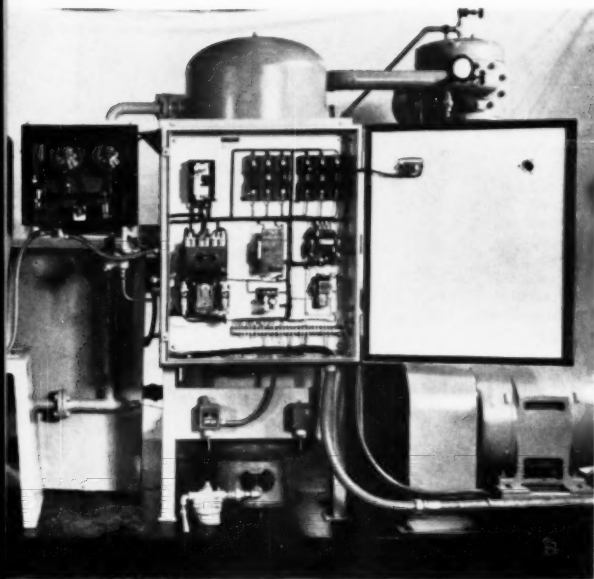


At the right are views of a unit designed to furnish 150 scfm at 100 psig of low dew-point air. This model, to be used by a leading electronics manufacturer in purging electronic equipment and for other uses, requires oil-free air, thus the compressor is a nonlubricated, carbon ring machine. Made by Ingersoll-Rand Company, the ESV-NL unit has a 9x7-inch cylinder and is driven by a 40-hp motor. As shown at the far right, the unit is complete with compressor cooling-water system serviced by an I-R KRVSA Motor-pump.

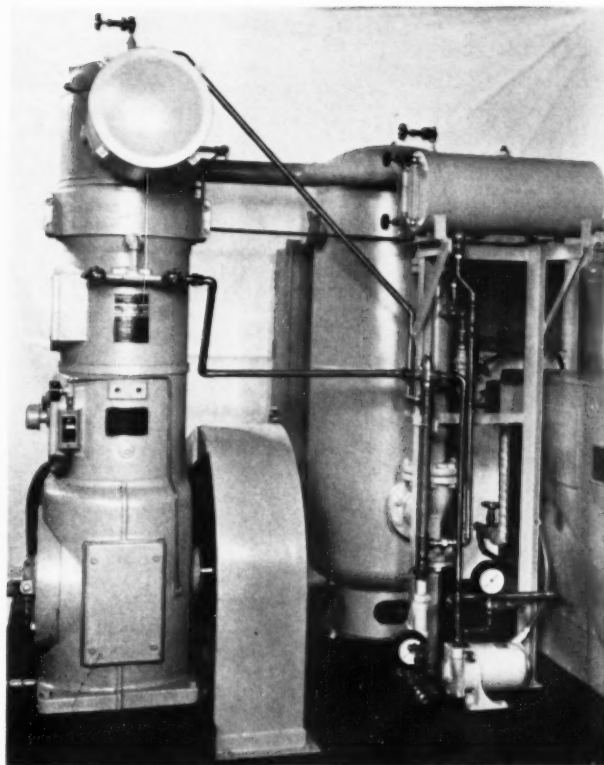
DRIER-COMPRESSOR PACKAGES

At right is another, smaller unit, designed to furnish low dew-point air. Its capacity is 25 scfm at 100 psig. Air is supplied by two I-R Type 30 compressors of 7½-hp each, one of which is a standby unit. Either compressor can operate as the base-load machine, thereby making it possible to equalize service time of the two units.





R. J. NEMMERS



Low Dew-Point Compressed Air

MOISTURE in air or gases presents a number of severe problems. In vital electronic systems of missiles and aircraft, in elaborate broadcasting and radar stations and in multicircuit transmission equipment of telephone systems, variations of temperature and atmospheric pressure cause housings and cables to "breathe" and to trap moisture. This in turn can cause not only electrical breakdown and short circuits, but may even result in changes in dielectric constants and variations in control frequencies. Coaxial cables and wave guides are particularly vulnerable to the latter. To guard against this troublesome moisture, such items of equipment are often charged with low-pressure gas (having a suitable low dew point) so that flow is outward, thus preventing moisture intake.

Spray painting and lacquering require air that is moisture free if the finished coating is to be of the highest quality. It has even been observed that the use

of very dry air in sandblast equipment can lengthen the time that metals cleaned in this fashion will remain free of oxidation.

There is currently a great deal of interest in mixing and agitating fluids with compressed air. In pharmaceutical and foods industries, for example, there are cases where the addition of moisture from the air to the solution cannot be permitted.

Systems that are tightly sealed, either for life or temporarily for storage or shipment, often are first purged with dry gas as a means of preventing internal corrosion.

The utilization of compressed air for conveying finely powdered or granular materials is important in the materials handling field. For strongly hydrophilic substances, however, "wet" air may cause sticking and clogging of transmission lines. For the same reason, "dry" or low dew-point air may be required in air-jet grinding equipment. (The

latter uses compressed air to entrain granular materials in opposing jets, hurling the two streams together; the resulting high speed impacts do the grinding.)

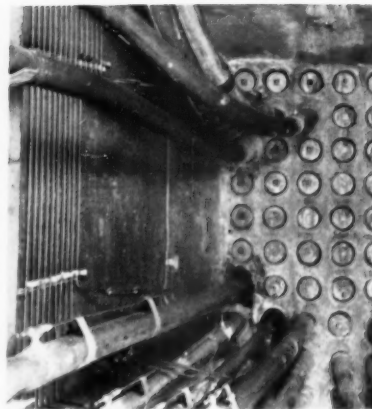
Complex air controls and gauging equipment with fine orifices and delicate adjustments also benefit greatly from the use of low dew-point compressed air. Not only does lack of condensate prevent water problems in the equipment, it also aids in preventing corrosion in the air system and the possibility that a bit of rust or scale will break loose from piping and obstruct the fine passageways of the equipment. In many of today's highly specialized proportional flow controls and gauges, for example, the clogging of an orifice can cause a shut down. Even the changing of its flow rate by a small foreign particle can have adverse effects.

All of these applications of low dew-point air, and many others, point out a new versatility of compressed air. In



CABLE PRESSURIZATION

One application of low dew-point air from a Heat-Les Dryer is shown here at a telephone company installation. The cables are pressurized with dehydrated air at 9 psig to exclude moisture, thereby preventing cable trouble. At one time the firm utilized bottled nitrogen for this service, but found dry air did the job as well at lower cost. At left, a plant employee is checking cable pressure. In the other picture, a cable vault is shown with each cable equipped with dried air inlets.



addition, there are some jobs having specifications calling for the use of gases other than air, in which compressed air of sufficiently low dew-point would suffice and do the job for less cost. Argon and nitrogen are often used for these applications. Both gases, when derived by the air liquefaction process, and not compressed by the so-called water pumping method, have inherent low dew points because of the low temperatures to which they are subjected during the separation process.

Several years ago a method of drying

air and gases to levels below the lowest measurable by available dew-point indicators grew out of basic research into drying and gas separation problems by the research laboratories of Esso Standard Oil Company. In comparison with dehumidifiers then available, the Esso development did not require the addition of heat to the drying cycle to regenerate the drying media. Working with Trinity Equipment Corporation, Cortland, N. Y., manufacturers of the Industrol line of heated driers, the development was brought to a practicable

stage. Today it is manufactured by Trinity as the trade-named Heat-Les Dryer under terms of a licensing agreement with Esso. The license permits the firm to manufacture and sell the equipment for air and gas drying applications.

The method of operation is relatively simple. As do heated driers, the Heat-Les unit utilizes twin beds of desiccant, one of which is "on stream" removing moisture from the air, and the other, being regenerated or in itself dried. The cycle time or interval during which one

Moisture, Humidity and the Dew Point

HUMIDITY to most of us, is best known in context with the familiar statement, "It isn't the heat, it's the humidity." Then of course, our complaint refers to the capacity of air to take up perspiration and thus produce a cooling effect on our skins.

Humidity is the term given to the water vapor content in air (or in any gas, for that matter). It depends on two conditions temperature and the amount of water available that can be vaporized. This water content or more precisely, its effects is described in terms of saturation and absolute and relative humidities. Saturation designates the total amount of water vapor that the air will hold at a given temperature. Absolute humidity is the amount of water in the air at a given time. Relative humidity is the ratio between absolute humidity and saturation, the former being expressed as a percentage of the latter. For some purposes it is better to have this data expressed in terms of temperature. The dew point is such an expression and refers to that temperature at which a given quantity of water vapor completely saturates a

gas. Often the dew point is utilized to indicate the minimum temperature to which a gas can be chilled without condensation of water vapor.

Water vapor in air is actually much more of a problem than just the discomfort that an excess can cause on a hot day. Some of its ill effects are listed in the accompanying article. These problems are intensified when air is compressed because, regardless of the relative humidity of the air at atmospheric pressure, the relative humidity of the same air at the same temperature but under pressure is always higher. One of the basic gas laws states that the moisture-holding capacity of any gas is inversely proportional to its absolute pressure. Thus air that is only 25-percent saturated at atmospheric pressure (15 psia), will be 50 percent saturated at 30 psia and completely saturated at 60 psia or only 45 psig. In normal plant air compressors operating in the nominal range from 90 to 110 psig, the relative humidity would be 200 percent or more. Why this moisture does not condense within the compressor cylinders is due to the increase in temperature associated

with compression. For each 20°F rise in temperature, the capacity of air for moisture is approximately doubled, thus the heat of compression effectively prevents condensation in the heated parts of an air system.

As soon as the air leaves the compressor and enters the service piping, it begins to cool and its vapor load condenses. This water, if introduced to air tools, interferes with proper lubrication and eventually raises maintenance costs. At valves and ports, where rapidly expanding air causes a drop in temperature, it can freeze and block the passages thus rendering the equipment inoperative. For these reasons, and a number of others, aftercoolers are required. They quickly reduce the outgoing hot air to, or below, ambient temperatures. Thus this excess moisture, as well as a certain amount of oil, are condensed where they can be easily and effectively trapped and removed from the system.

It should be remembered that the air leaving the aftercooler will almost invariably be saturated at the discharge temperature. The relative humidity of

tank is on stream, and the other being regenerated, differs considerably however, from the heated variety. In the latter, cycles may range upwards to 4 or more hours in length. In the non-heated, switching time is measured in minutes; 1- to 2-minute intervals being common.

The Heat-Les Dryer, for its success, depends on pressure differentials, and the tendency of desiccants to come to equilibrium with their environments. The higher the pressure of the incoming air, the more efficient the operation. The cycle is as follows:

A stream of compressed air (it is recommended that it be passed through a normal aftercooler-separator installation) is directed into tank A, where its water vapor load is adsorbed by the drying media or desiccant.

As the effluent stream emerges from the tank, a portion of the dried air supply (about 10 to 13 percent in the case of a unit delivering dried air at 100 psig) is diverted through an orifice, expanded to atmospheric pressure and directed in back flow through tank B. The stream picks up the moisture deposited there on the previous cycle and then is discharged to atmosphere. This so-called purge air stream has an enormous capacity for moisture because it was dried

to a dew point of something less than minus 100° F at 100-psig pressure and thus has a correspondingly lower relative humidity at atmospheric pressure.

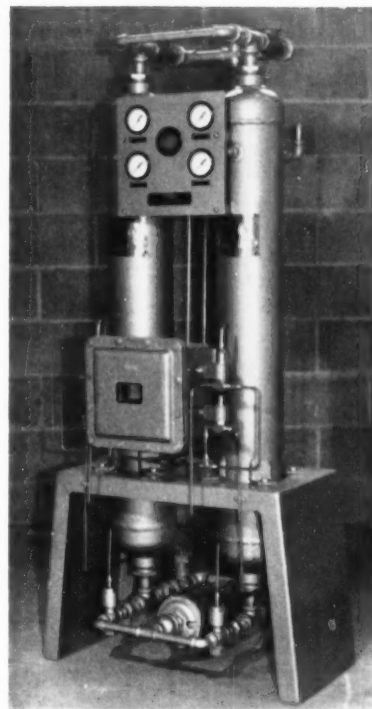
At the close of the short interval of back flow by the purge stream, the discharge vent on tank B closes and the purge air repressurizes the tank. Then a set of valves switch and tank B becomes the drying tank, while A is vented quickly to atmosphere. This sudden expansion of the air in tank A removes a great deal of the moisture adsorbed on the desiccant. This occurs because, although the air within may be approximately saturated, when its pressure is sharply reduced its relative humidity decreases rapidly (to less than 15 percent in the case of 100-psig air).

In many respects, the rapid expansion of the air within the desiccant tanks to atmospheric pressure does the greatest amount of moisture removal. The reason for this is not completely understood, for it appears that perhaps more moisture is removed than can be accounted for. Indeed, one of the units has been successfully operated for extended periods of time without the use of purge air to complete the regeneration of the desiccant bed. Only the switching from one tank to the other was maintained, along with the rapid dumping to atmosphere of the compressed air at the end of the standard cycle. At no time during the test did examinations of the effluent air indicate a leakage of water vapor past the desiccant tanks, indicating that they were becoming saturated very slowly, if at all. This, of course, provides a built-in overload capacity in the driers. It is not recommended, however, that a unit be operated for any length of time without full regeneration of the desiccant by means of the purge air stream.

the atmospheric air would have to be well under 15 percent for less than 100 percent humidity conditions to prevail at 90 psig, assuming that the aftercooler reduces the temperature to within a few degrees of ambient temperature. The air is thus at its dew point; and should there be any further reduction of the temperature, condensation will result. For this reason water traps and legs are recommended for all air systems to drain off any further condensation.

Compressed air at these conditions is perfectly satisfactory for a wide variety of uses. There is a growing list of applications, however, where the air should be considerably drier. To handle these requirements, there are a number of driers commercially available. Most use desiccants to adsorb water vapor from the air and then utilize heat to drive off the adsorbed water to regenerate the desiccant for further use. A recent development, described in the accompanying text, does not require a heat source for desiccant regeneration. It can produce dried air to dew points consistently at, or below, minus 100° F.

Trinity sells the Heat-Les Dryer either as a separate unit, or as a package having a compressor, regulatory equipment and holding tanks. In this respect, the equipment can be built to handle relatively low volumes of high pressure air, storing the air in tanks at the same pressure and then reducing it to any required pressure or pressures for utilization. At the present time the firm builds 18 standard units which, at 100 psig and operating on a 1-minute cycle, deliver from 2 to 1500 cfm of air. Higher pressures result in an increase in the capacity of any of the units, whereas lower pressures result in a decrease. The firm is now readying for the market units for pressures to 6000 psig and volumes to 5000 cfm. One of the largest of the Heat-Les dehumidifiers yet ordered is for a wind tunnel and illustrates still another use for dry air. Control of humidity in environmental testing is very important. Thus all air used in some installations is dried to a uniform level and then moisture



HEAT-LES DRYER ASSEMBLY

Shown here is a standard drier assembly (with explosion-proof controls) as sold for use with a customer's air supply. The desiccant tanks are readily identified. The outlet piping loop is at the top, the intake, at the bottom. Centered in the intake loop is the exhaust muffler through which the tanks are exhausted at the end of each cycle and through which the purge air stream is discharged. The unit has a capacity of 72 scfm at 100 psig utilizing 85 scfm at the inlet.

added to bring the humidity to the exact desired test level.

Not only is the Heat-Les Dryer utilized for drying compressed air, but it can be used, with suitable desiccants, for any gas or mixture of gases. Besides removing moisture, it removes a great deal of oil vapor as well. Tests of the effluent gas stream from a properly functioning drier receiving air from a standard lubricated compressor, show oil concentrations of less than 1 part per million. The adsorption of oil onto the desiccants is a common feature of all types of desiccant driers, however the Heat-Les unit has one advantage. In heated units, this oil vapor is baked onto the desiccant forming a hard coating. This, of course, renders the desiccant useless for further adsorption work. In the Heat-Les variety, much of the adsorbed oil is flashed to vapor by the dumping of the tanks and a great deal more is revaporized by the purge air stream. Thus the Heat-Les unit, claims its manufacturer, is less susceptible to desiccant poisoning by oil.

Components Construction Creates—

HOUSES FROM A FACTORY

G. R. SMITH



ROOMY RANCHER

This is the Hempstead, one of Presidential Homes' ranch-style homes. By using components construction, the packaged shells of many houses can be erected in as little as one working day. Air power helps assemble many of the components.

HOW to provide thousands of new homes for a rocketing population while still achieving individuality for each dwelling and avoiding the drabness of the mass-produced, row-of-dominos housing development?

One company that offers a solution to this modern-day dilemma is Presidential Homes, Inc., Pemberton, N. J. It is, as it describes itself, a producer of "factory built" dwellings in the medium-price range. Thumbing through the company's descriptive brochures, a person will discover that Presidential Homes offers a customer a line of no less than 180 different houses. These run the breadth of popular home design in present-day America. There are the split-levels, the Cape Cods, the colonials, the ranchers, the one-and-a-half stories and the two stories. A few have two bedrooms but by far the majority have three, four or five—well-built, roomy homes for growing families. Each model

is identified by a name, usually suggesting pleasant suburban living that tends to personalize the home and therefore make it attractive to the potential owner. One of the 2-story houses is the Cambridge, another is the Lexington. A rancher is named the Livingston. A Cape Cod is called the Fairfield. Three split-levels are the Connecticut, the Saratoga and the South Hampton.

Components Construction

Because of the connotation, Presidential Homes shuns the term "prefabricated" and prefers the expression "com-

ponents construction." Orders are processed through the company's architectural and engineering staff at Pemberton where each component is completely designed before it is cut to order in the company shops. This staff of some eleven men provides design depth, and as if the availability of 180 individual styles weren't sufficient, it also allows a customer to make deviations as he wishes from a stock model. This freedom transforms the large but fixed number of models into nearly an infinite variety while still retaining close control on the actual basic unit. Moreover, because an assembled Presidential Homes' "package" is a shell, it leaves the final finish work to the builder, and consequently, in many cases, to the owner. The exterior covering, the roof covering, the finish flooring, the plumbing, heating and electrical installation are all the choice of the builder. This supplies versatility to both the large volume

Presidential Homes Profile

PRESIDENTIAL HOMES, INC., was created in 1954 with the purchase of The Johnson Quality Homes Company. As explained by Presidential Homes' tall, energetic president, Richard L. Duffield, modernization has been continuing each year since the new company was founded. This has included both physical improvements at the home offices and shops, and increasing the efficiency of the sales organization in the field. Presidential Homes' sales force is active in the middle-Atlantic and northeastern states and extends westward to middle Ohio. This area provides more than enough sales potential for the company's output (which Duffield estimates will be approximately 1400 units for 1959) and trucking the houses greater distances would be uneconomical. An independent company

not affiliated with larger nationwide builders, Presidential Homes, believes Duffield, offers its customers a flexibility larger builders cannot possibly match. Both civilian and military orders are received.

Air tools were instituted at the Presidential Homes factory about 2 years ago, shortly after Tom McClary joined the company to become shop superintendent. McClary was amazed to see literally tens of thousands of nails being driven with hand-held claw hammers. Air units had been used at McClary's previous job. The Ingersoll-Rand air-powered Nail Drivers were brought in a while later, with the resulting labor savings ranging between one-third and one-half, depending on the operations involved.

When one drives up to the Pemberton

factory, he will note that two other companies have their headquarters in the same plant. These are subsidiaries of the parent company. One is Congressional Homes, Inc., a line of custom-built higher-priced houses that are produced much like Presidential Homes models but require more time of the architect-engineer staff. The other company manufactures the Newport line of fiber glass boats and provides diversification. This operation also uses a great deal of compressed air power.

The Presidential Homes operation, under the direction of its president, is handled by an executive staff organized as follows: H. G. Bielefeld, vice president, manufacturing; Donald J. Peters, vice president, sales and marketing; E. L. Tillinghast, vice president, liaison; and John Horn, chief engineer.

builder erecting many houses as well as to the smaller builder who may put up only one or two dwellings.

Construction's Advantages

All materials that comprise the Presidential Homes' package are precut, bundled and marked for identification. When the flat-bed trailers carrying the home components arrive at the home site, assembly begins immediately if the foundation has been prepared previously, as is usually the case. At this time the major advantage in component

construction begins to be realized: Only one skilled carpenter is needed to erect a house. He usually supervises four unskilled helpers. This means great labor-cost savings over the expense of utilizing several skilled men. Further, because the components for the house are already cut and many assembled, total man-hours of labor are few. (The major parts of the houses that have already been put together are the walls and partitions; floors, roofs and ceilings are precut. Some on-the-job cutting is necessary.)

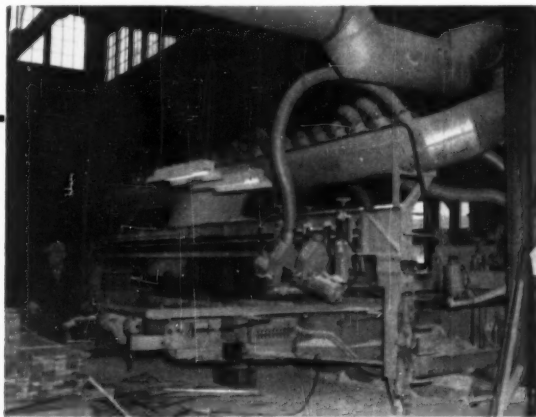
Presidential Homes adds that several

other advantages are gained from this type of construction. Faster erection (shells of some models can be put up in 1 day) means faster and less costly scheduling of plumbing, heating, electrical work and inspection. Materials handling costs are reduced because large instead of small pieces are moved. No inventory of materials is needed on the site because the components are delivered the day of construction. There is almost no waste because nearly all parts are cut to fit. There is little chance of pilferage because the building goes up quickly.

Because it uses about 10,000,000 board feet of lumber a year, Presidential Homes has what appears to be a couple of well-stocked lumber yards on its grounds. Stacks of both 2-inch and larger-dimensioned lumber are visible here.



After leaving the lumber pile, these 2x4's are moved to the shop for cutting to correct length. A workman at left feeds them into the conveyor at a high rate. Sawdust from the blades is blown up the ducts above the saw, to a hopper above the building.





NAIL DRIVER

An operator starts a nail into an exterior panel plate using an Ingersoll-Rand AVC-13 Nail Driver, a lightweight air-powered tool. A total of only about 3 seconds is needed to drive the two nails that hold plate to stud. A workman swinging a claw hammer takes twice the time, expends much more energy and often wastes nails by bending them.

Interior walls are made the same way, spacing of studs being carried out as prescribed by FHA requirements for various dwellings. The 2-inch lumber for the panels is cut to precise lengths on a many-bladed saw that can handle several hundred studs an hour. Blades on this large saw are moved transversely along a beam on the machine to select the desired cutting length. A worker feeds the lumber into a flat-bed conveyor that carries the pieces singly into the blades. Blowers mounted directly above each saw blade suck the sawdust from the cutting edges and blow it through ducts to a large hopper above the Presidential Homes' building. After cutting, the lumber is moved to storage bins next to a long assembly line.

Two hundred feet in length, the assembly lines have mounted on them templates that form outlines of the panels to be built. The 2x4's are put in place on the templates, then two men work on opposite sides, driving two special nails through the plates into the studs resting against them. This operation is the prime use of air power at the factory. Presidential Homes has 30 Ingersoll-Rand AVC-13 air-operated Nail Drivers for this and other nailing jobs. This lightweight tool with a pistol grip drives a nail when the operator's thumb actuates a throttle lever on top of the

Fabrication and Air Power

The Presidential Homes' package consists essentially of sub-flooring and its supporting members, exterior and interior wall panels, inside partitions, roof and ceiling structures, windows, doors, stairs, closets plus outside and inside trim and hardware. After the components breakdown has been sent from the design section to the Presidential Homes' workshops, the two main tasks in preparing the components are cutting and nailing. Because of the large volume of homes which the company produces, these two operations are necessarily handled on a high production, standardized basis. The two wall panels, exterior

and interior, are perhaps the best examples of how this is done. Air power is absolutely essential in fabricating these, as it is in preparing many of the components.

The exterior units consist of 2x4 plates, and 2x4 studs, 8 feet long placed on 16-inch centers. The panel widths vary with the house being pre-cut but all panels are necessarily easily erected by two to four men. A stock model of a home can be altered either slightly or drastically by adding to or subtracting these 16-inch sections from the panels. Before Plyscord (plywood) sheathing is applied to the studs, a batt-type insulation is installed after sheathing is put on windows are installed as required.

This is the long assembly line where workmen using air-powered Ingersoll-Rand AVC-13 Nail Drivers fasten plates to studs to form the framework of exterior and interior panels. When in full-scale operation, this line bristles with several nailing teams.



Its components either assembled or cut to approximate length, a Presidential Homes package awaits shipment on this tractor trailer. Assembled panels are resting on top of heavier stacks of individual boards.



MEDICINE CABINET FRAME

This Ingersoll-Rand Nail Driver is being used to assemble an interior partition containing a framework where a medicine cabinet will fit. Jones & Laughlin's Ardox Nails, light spiral fasteners with wood-screw action, are used because they have high holding ability and seldom split boards.

grip. Originally designed as a light-weight riveter, the units are fitted with nail sets to equip them for nail driving. The nail set forms a sleeve about the nail and keeps the tool centered during the few seconds needed to force the nail into the wood. As the tool is actuated, the nails go in with a quick "b-u-r-r-r-t."

Powered by 100-psig plant air from a 20-hp vertical compressor, each air-powered Ingersoll-Rand Nail Driver approximately doubles the output of a man who sets aside a claw hammer and picks up the AVC-13 unit. A man using a hand hammer will spend about 6 seconds pounding two 16-penny nails into the 2x4's of a panel. With the air-operated tool, the nails are in place in about 3 seconds. Jones & Laughlin Steel Corporation's Ardox nails are used with the Ingersoll-Rand Nail Drivers. These special spiral nails utilize the same principle as a wood screw. They are easily driven because of the spirals, have more holding power and split less wood than ordinary nails.

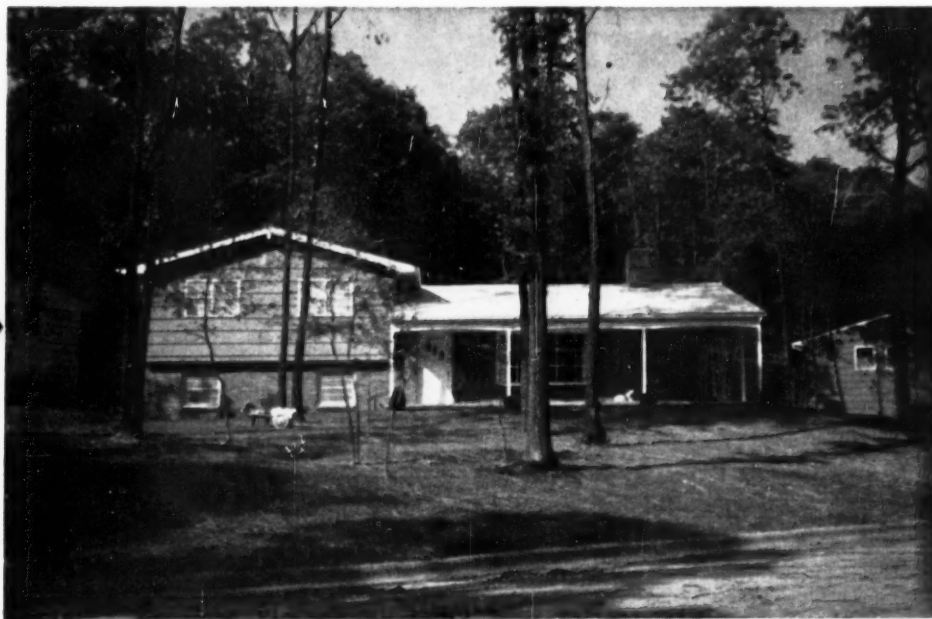
During a project of building several hundred homes for a single developer, located only a few miles from Pemberton, Presidential Homes had the opportunity to observe the considerable cost savings possible with the use of air tools, compared with the manual methods used



in the past. The project lasted about 6 months—June to December 1958—and the air tools were in use for 20 weeks. Varying with seasonal requirements, Presidential Homes' labor force runs between 100 and 300 men. During this period 20 men were working on the assembly line fabricating panels using the Nail Drivers. For this project the company estimates the tools produced about a one-third labor cost saving. The 20 were earning \$2.30 per hour for a 40-hour week, a weekly total of \$1760 in wages. For the 20 weeks the total payroll, therefore, was \$35,200. The company calculated that without the air tools, and using manual methods,

wages would have cost \$50,000. This resulting saving of \$14,800 still amounted to \$8900 after subtracting the expense of the air tools and the compressor.

Since that time the saving resulting from the change to air power has been completely "clear," of course, because the tools long ago paid for themselves. The I-R Nail Drivers are used for many other operations in putting together components of the varied Presidential Homes packages. Even the frames in the interior partitions that eventually will support medicine cabinets in the finished houses (see illustration) are nailed together with the handy air tools.



Erected and finished, this split level represents the eventual end product of the Presidential Homes operation. After the shell has been put up, the house becomes an individual one because both the outside and interior finish are added by the owner.

The Thompson Ramo Wooldridge Inc. Story

Part II

T A P C O

A Portrait of An Air Plant

S. M. PARKHILL

DIVERSITY and scope best describe the growth and policies of Thompson Ramo Wooldridge Inc. The company's organization is one of the few in the United States that lists two official headquarters on its letterhead and in its advertising, and those are about 2500 miles apart. The product line ranges from sound systems and television sets to military missile components. A progressive company philosophy of anticipating new "industries" resulting from technological advances, together with a young management team, has made this true. As described last month, the corporation's plans reflect its history and indicate its future.

Like the other divisions, the Tapco Group, based in Euclid, Ohio, has a rigorous manufacturing role to achieve if the over-all company aims are to be accomplished. Its function is best equated to that of a jobber; that is, to develop and supply parts and specialized devices, equipment, controls and systems to meet the everchanging defense needs.

The Tapco Group is composed of the company's former Jet, Accessories and Pneumatics divisions; the West Coast (aircraft operations) Division; and the Cleveland operation of the Electronics Division. It is grouped under the leadership of Stanley C. Pace, vice president and former manager of the Jet Division.

The Tapco Group manufactures missile and aircraft auxiliary-power, ground-support, fuel, hydraulic, pneumatic and electronic-control systems; microwave switches; frame structures and pressure vessels. It also constructs jet engine compressor blades, rotors, stators and

impellers; turbine engine cases, nozzles and pumps; nuclear reactor control rods, pumps, accessories and core structures; precision investment and continuous vacuum-cast parts for aircraft, missiles, jet and rocket engines; and vacuum-cast super-alloy ingot, billet and mill shapes.

With such a broad line, it is easy to understand how production and plant maintenance can be complicated tasks—the bailiwick of W. J. Collier, manager of Tapco Plant General Services, and his young assistant C. T. Bingham.

Their job is further complicated by the sheer size of the facility. When Tapco Plant No. 1 was added (See COMPRESSED AIR MAGAZINE, August 1959), it increased the company's total floor area by 1,100,000 square feet.

Ground was broken for the plant on April 14, 1942, and by December 2 of that year, while the plant was still windowless, the first sodium-cooled valve slug came from a forging machine. The company was ready to do its share in building the war-waging colossus that was to be required after the Pearl Harbor attack just 5 days later. Construction of Tapco Plant No. 2 began in June of the following year, and it was in production after only 8 months. Building costs totaled \$30 million, of which \$22 million was spent for machinery and equipment.

The plant has a modern layout. Its lighting and equipment are of the best quality; and the accommodations for employees, from parking lots to cafeterias and landscaping, help make this one of America's industrial showrooms. High standards of cleanliness and safety

are maintained constantly, and only the best of equipment has been installed to do the work.

The Colony System

As stated above, Tapco's principal job is to furnish parts or components for aircraft and missiles. In this sense, it is a supplier. It is also a manufacturer. Most of the parts ordered must be fabricated to exacting specifications, even though the number of completed components ordered at one time is small; they cannot be taken "off the shelf." Because the vast number of individual components required to put Government missiles into the air, keeping them on course and functioning effectively, are constantly being redesigned, the orders placed with the division are seldom duplicated, or so it would seem.

Each incoming order requires a special tooling set-up even though its final production run may be for only a few thousand pieces. A production line process, as typified by the automotive industry, would be out of the question because of the complex material-handling efforts that would be required to move workpieces from one part of such a line to another, by-passing unnecessary steps. Consequently, the plant engineers selected the colony system of production—a system that few other factories with standardized lines can utilize effectively and at a cost savings.

When an order is placed, tooling for the fabrication of the specified component is planned. The necessary production machines are moved to a centralized area and are arranged in that one lo-



cation so that movement of material from one work area to another will be done in the most efficient manner. When the order has been completed, the machines are pulled out and moved to the next prearranged set-up where they go into operation to fill another order.

Certain pieces of equipment that require extensive foundations, such as forging machines, cannot be moved. These are centrally located. To transfer material to and from them, fork trucks are utilized. Each is equipped with a radio and is dispatched from a central call station.

A visitor at Tapco immediately notices the number of hanging air lines. Some are in use, others are waiting to be attached to machines that have not yet been scheduled for a colony set-up. The plan presupposes an ample supply of air power that is readily available at all locations.

By extension, there must also be an adequate air supply source; that is, one that is capable of furnishing the required shop air instantaneously and efficiently no matter how great the distance is between the compressor house and the working area.

At Tapco there is a need for high-pressure air at fixed locations to test completed missile systems, too. This double requirement was met by decentralizing the air plant. One compressor house contains all the necessary units for furnishing general shop air. By using a single installation, labor costs are reduced, supervision is better, and operation and maintenance are more unified than if the shop air were supplied by four compressors scattered about the

facility. High-pressure air plants supplement the shop air system. They are placed close to individual test bays, thereby assuring adequate air at the required pressures at all times in the strategic load areas. Too, with the sites of the high-pressure air systems close to working areas, extensive and costly piping has been eliminated. In each case, the subsidiary booster compressors are grouped in special areas that could almost be termed *plants* in themselves. In this way, the plant engineers further assure that maintenance will not be neglected through oversight or inaccessibility.

Shop Air

Shop air is furnished at a nominal 100-psig discharge pressure from four identical 600-hp units, each with a rated discharge of 3190 scfm. The compressors are 30 \times 18 \times 22-inch Ingersoll-Rand Class PRE-2 units, driven by direct-connected synchronous motors at 200 rpm. The air is drawn from atmosphere through Dollinger filters, boosted to its working pressure and passed into vertical receivers. From them, it is used for general pneumatic tool applications, hoisting, air honing and similar compressed air jobs throughout the plant.

The compressor installation is located at the center rear of the manufacturing facilities. The room is ideally designed. It is exceptionally clean and light, and has adequate space for pulling pistons and cooler tubes for cleaning and periodic inspections. However, the total floor area is not quite enough to house the four compressors in line if they were

INDUSTRIAL SHOWPLACE

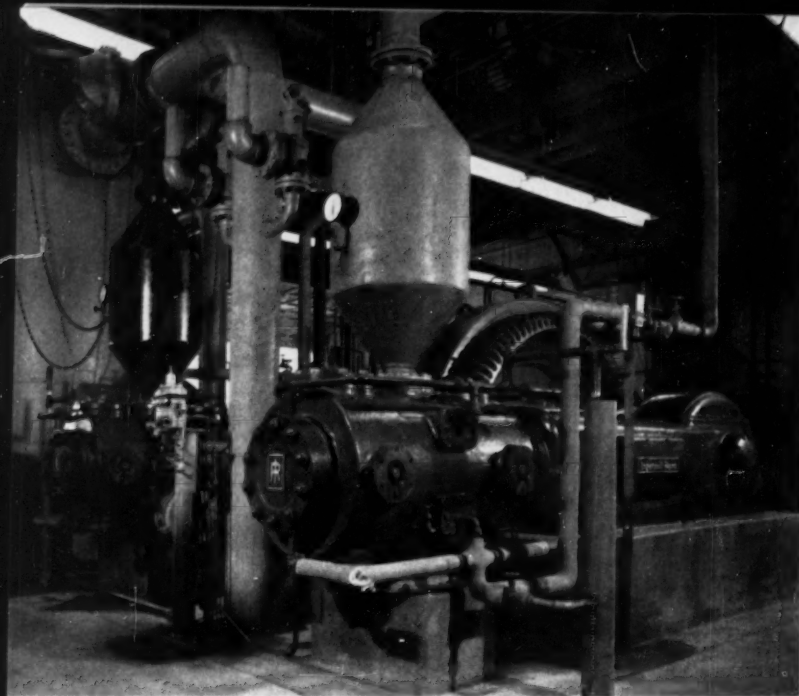
The Tapco plants were built in 1941-43 at a total cost of \$30 million. Their modern layout and high standards of cleanliness and safety reflect Thompson Ramo Wooldridge's product and reputation. Today, besides the manufacturing facilities, the Euclid, Ohio installation also houses one of the corporation's headquarters.

equipped with normal-sized intercoolers and still have room for periodic maintenance. Special intercoolers, somewhat shorter than the standard, were purchased from the compressor manufacturer. Although not as long, they were designed to perform the most important function of all intercoolers—that of reducing the temperature of the air as it passes from the first- to the second-stage compressor cylinder, thereby making the cylinders operate more efficiently and helping to assure their longer service life.

Each of the PRE-2's utilizes 5-step clearance control, reducing the capacity step-by-step in five approximately equal steps from full- to no-load, depending on the varying shop demands.

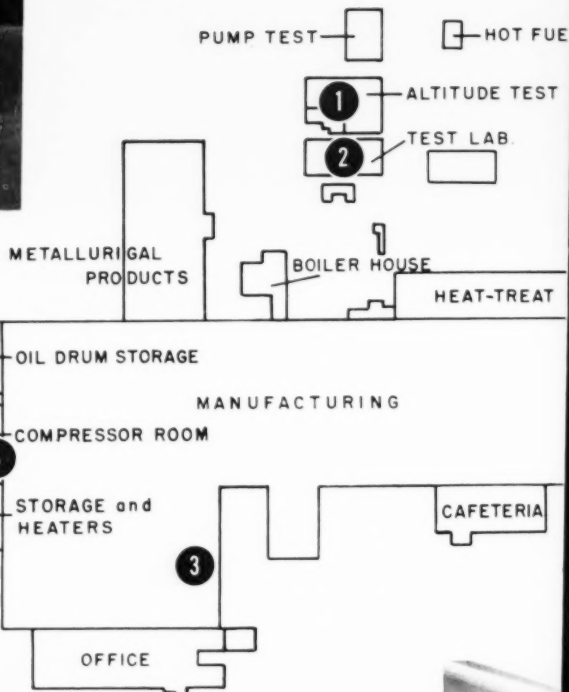
Test Air

Air for one of the test laboratories is furnished by three high-pressure booster compressors that have a total discharge capacity of 3700 scfm. Like those for the general shop air, they too had to be placed in a small area—a narrow passageway between two large manufacturing floors. To make such an installation possible and practical, the units were placed side-by-side, with each long axis running parallel to each other



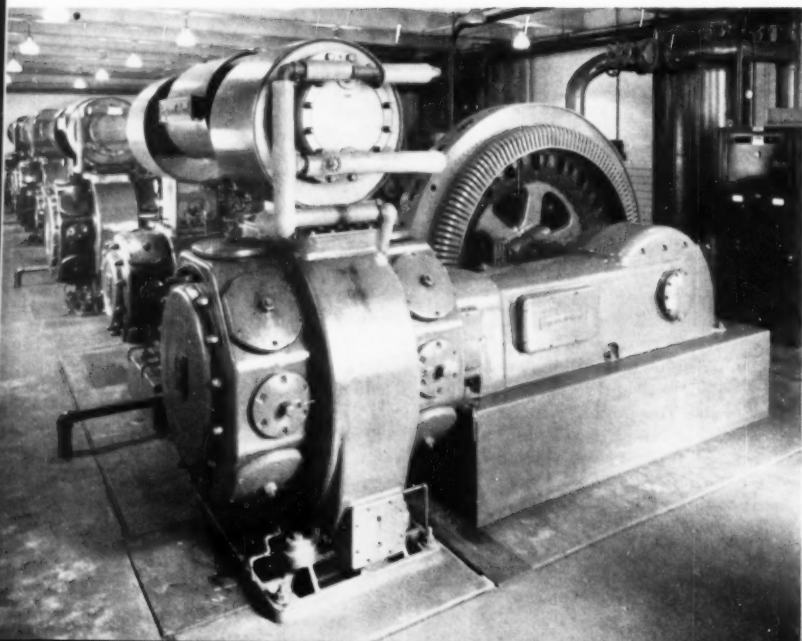
PUMP TEST AIR

1 Dominating this compressor installation are two Ingersoll-Rand 500-hp PRE-1 booster compressors that have a combined discharge rate of 12,000 scfm. They furnish air at a maximum of 300-psig pressure for testing pumps used in missiles. Each utilizes 5-step clearance control and draws its initial air from the shop system. The units, purchased in July 1954, are driven by 60-cycle, 4800-v, 225-rpm Westinghouse motors.



PLANT LAYOUT

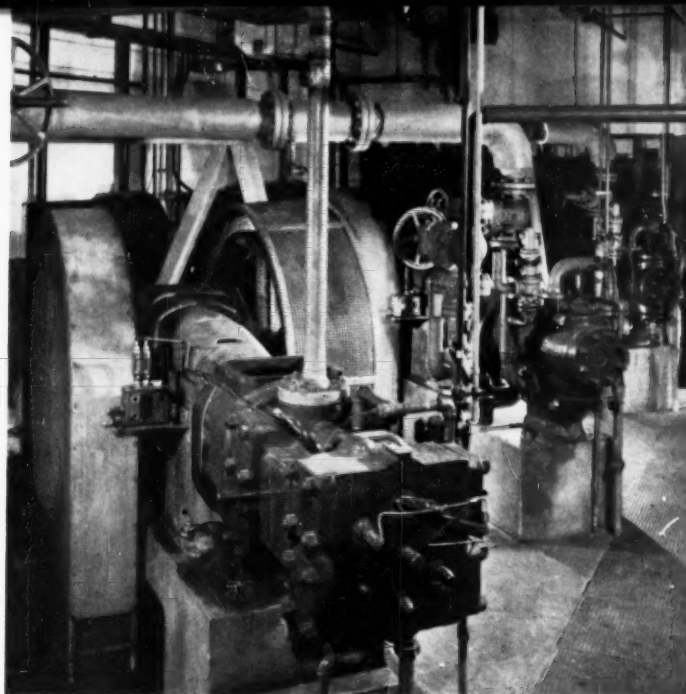
A general indication of the plant facilities at Tapco is given by this outline sketch of the plant. Because of the size of the installation and the variety of the product line, a colony system of manufacturing is used. To meet the rigorous and instantaneous demands for shop air as well as localized requirements for high-pressure air, the compressor house was decentralized. The photographs around the center sketch show some of these installations and describe the equipment in each.



SHOP AIR

4 Four 600-hp Ingersoll-Rand PRE-2 compressors furnish 100-psig pressure air at a total discharge rate of 12,760 scfm. They are driven at 200 rpm by E-M motors drawing 4800 v, 60 cycles. The last compressor of the group was purchased in January 1956. Because of the close quarters, specially built inter-coolers were supplied, as described in the text.

EST



TEST AIR

2 The two units in the background are Ingersoll-Rand Class ES-1, $7\frac{3}{4} \times 13$ -inch compressors. They boost air from the nominal 100-psig pressure of the shop air to 300 psig. The unit in the foreground is a $5\frac{1}{4} \times 13$ -inch ES-1 high-pressure booster compressor. It raises the air pressure from 300 to 750 psig. Each is rated at 125 hp. and is driven by a General Electric 60-cycle, 440-v, induction motor.

and at an angle to the wall of the building, in much the same way as automobiles park at an angle to the curb. By such an arrangement, maintenance and repair crews have adequate working space, but the over-all area is not excessive so as to hinder shop traffic—an important consideration in an over-all effort to eliminate today's common complaint of rising costs.

These units are 125-hp Ingersoll-Rand Class ES-1 compressors. Two have $7\frac{3}{4}$ -inch cylinders and 13-inch strokes; the third, with the same length of stroke, has a cylinder with a $5\frac{1}{4}$ -inch bore. The two larger ones draw their air from the 100-psig pressure shop air and boost it to 300-psig. The $5\frac{1}{4}$ -inch compressor boosts the 300-psig pressure air to a pressure of 750 psig for testing missile systems. Each is driven by a General Electric 60-cycle, 440-v, induction motor rated at 125 hp.

A second test-air supply system, located some distance from the principal compressor house, but near its place of use, consists of two Channel-valve-equipped, 125-hp Class ESV-1 units, driven by 60-cycle, 480-v, General Electric induction motors. They boost 100-psig pressure shop air to 750 psig to simulate high-pressure conditions prevalent in rocketry. Each discharges at a rate of 600 scfm.

The vertical $5\frac{1}{2} \times 11$ -inch compressors were selected because they could furnish the air that would be required at the pressure needed, and yet, they would fit into the available space. Had horizontal (ESH-1) units been chosen, the actual length of each compressor would have been increased by about 3 feet. The width would have been approximately the same, the height would have been about 2 feet shorter. As with the other installations, there is ample room for maintenance crews to work.

A third, high-pressure system is dominated by two Ingersoll-Rand 500-hp, PRE-1 booster compressors of $10\frac{5}{8} \times 19$ -inch size. They discharge air at a combined rate of 12,000 scfm and at a pressure of 250-300 psig. As in the preceding cases, they are located away from the central air plant so that they will be closer to the job at hand. In this case, however, they are located in a compressor room that is some distance from the main manufacturing building.

The arrangement of the plant and the locations of the various compressor stations are indicated on the accompanying sketch. The positioning of the compressors in their respective locations, and the spotting of these separate air systems throughout the facility are readily apparent. By this means, Tapco found a way to control its diversified product line so that it might more readily benefit the over-all Thompson Ramo Woolridge objectives.

SPACE SAVER

3 This vertical Ingersoll-Rand Class ESV-1 was selected because of the limited horizontal space. It is one of two compressors used to furnish testing air at a rate of 600 scfm and a pressure of 750 psig. They were purchased in February 1957, the latest of the I-R compressors to be installed at Tapco. They are driven by a General Electric, 60-cycle, 480-v induction motor.

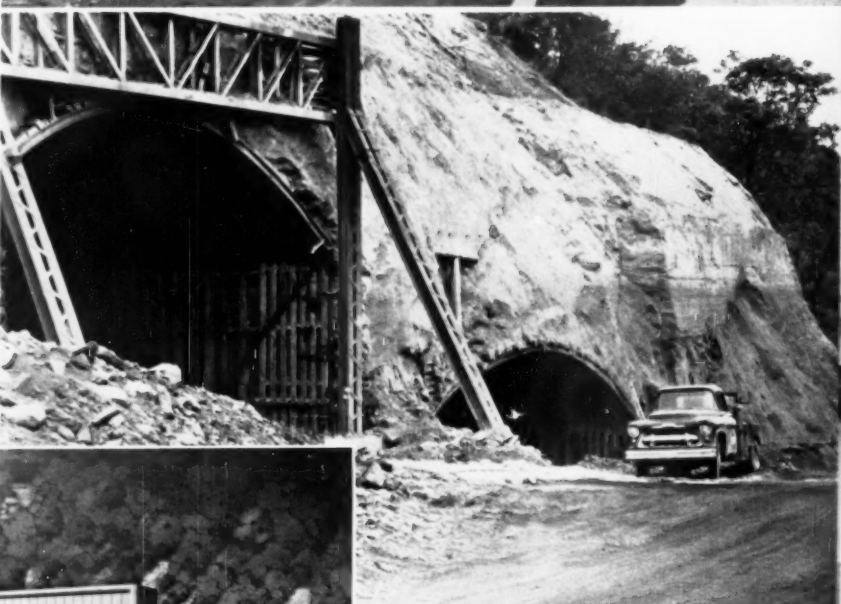


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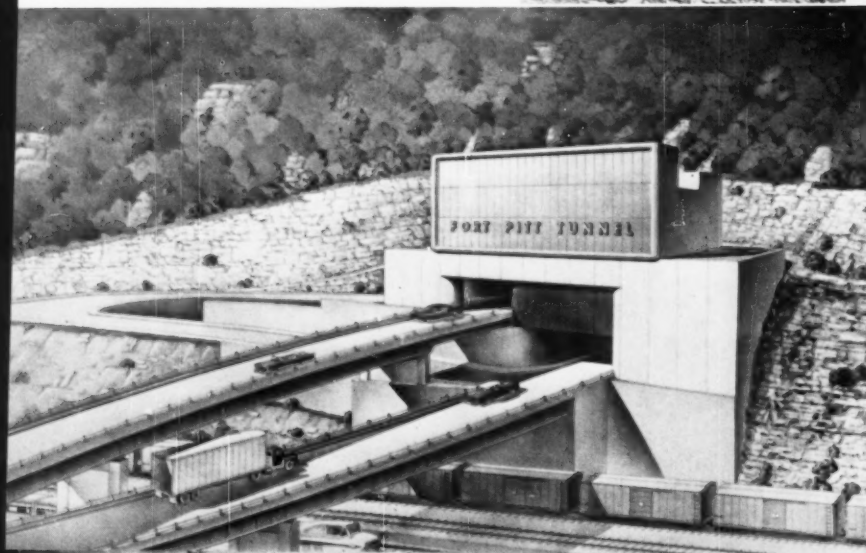


SOUTH PORTAL

The drawing at the top is an artist's conception of the South Portal when it will be completed in September of next year. The actual site is pictured at the right. Both tubes start at the same level. The other drawing below is of the North Portal. The upper tube is the north-bound lane into Pittsburgh's Golden Triangle. The picture at the right was taken at the site and clearly indicates the 18-foot difference in the elevations of the north- and southbound tunnels.



NORTH PORTAL



Pitt Tunnel

Solving problems of pneumatically placing concrete has helped push the project well ahead of schedule

WHERE the Ohio, Allegheny and Monongahela rivers conflow sits the Golden Triangle—the heart of Pittsburgh, Pa. About 500,000 suburbanites living on the south banks of the Ohio and Monongahela cross these rivers to get to the downtown business district. Although there are more than 30 highway and railroad bridges in the area, the morning and night traffic has been a nightmare.

The need for an artery connecting the suburban areas more directly with The Point, as the residents call this area of Pittsburgh, was a necessity. To furnish it, a tunnel has been driven under 325-foot-high Mount Washington on the south bank of the Monongahela. It will connect with Fort Pitt Bridge that spans the river. The vehicular tunnel is being constructed as a part of the U.S. Federal Highway Act (1955) whereby the Government contributes 90 percent of the estimated total cost—in this case, \$14,400,000—and the State pays the balance, or \$1,600,000.

Fort Pitt Tunnel, as it will be called, was designed by Michael Baker, Jr., Inc., consulting engineers of Rochester, Pa., and the contract was let to Merritt-Chapman & Scott Corporation. It will consist of two 12-foot roadways and 23 $\frac{1}{4}$ -foot-wide sidewalks. The inside width of each tube, face-to-face of the sidewalls, is 29 $\frac{1}{3}$ feet. The minimum thickness of the concrete lining is 13 $\frac{1}{4}$ feet. The northbound tube, which will be 18 feet higher than its companion way, will measure 3437 feet in length, while the southbound one will be 3432 feet long. Clearance from the roadway to the ceiling will be 14 feet.

Tunneling has proceeded at about 32 feet per day, blasting and mucking 224,000 cubic yards of rock. Operations for both tubes began at the south end, drilling, blasting and mucking alternately from portal to portal 24 hours a day. Air for the drilling and for the concrete-placing equipment is being furnished from a 2-compressor installation at the south portal. The two units have a combined capacity of 1750 cfm.

The roof and sides of the newly cut tubes were shored by steel members: 31-pound, 8-inch steel H beams at the

sides; and 40-pound, 8-inch members for the arch. These post-and-arch assemblies are set on 4-foot centers, the spaces between being filled with steel channel lagging.

Approximately 70,000 cubic yards of concrete will form the roadway, line the sidewalls and arches and form the 5 $\frac{1}{2}$ -inch-thick ceilings. Concrete was batched at the main plant of Marion Coal & Supply Company, Pittsburgh, and delivered to the site by four high-discharge, 9-yard mixers, plus three 7-yard and three 6-yard transit mixers.

Concrete production was on a demand basis, but averaged 400 cubic yards per day during the pouring of the tunnel lining. To produce the daily requirement, Marion supplemented its regular facilities with a new set of Hatzel batching, selecting and weighing equipment that provided a double set of 4-compartment bins. With this increased capacity, two trucks could be loaded within 5 minutes. Twenty-four 9-yard loads, eighteen 7-yard loads and eighteen 6-yard loads were delivered within a 6-hour period each day. Because the Pennsylvania State Highway Department prohibits mixing while in transit,

concrete was mixed for 3 minutes at the site before pouring.

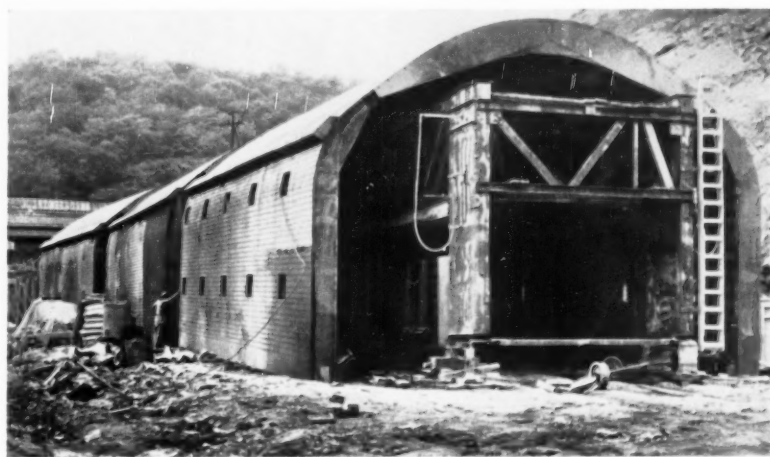
The trucks were backed into the tunnels and the loads placed on a conveyor that carried the concrete into a hopper of a 1 $\frac{1}{8}$ -yard Press-Weld pneumatic concrete placing machine. From the hopper, it was shot through a riser pipe and slick line that spanned distances as great as 90 feet to reach the tunnel forms.

Placing 2 yards a minute, workers filled one 50 $\frac{1}{3}$ -foot-long Blaw-Knox tunnel form in about 6 hours, using about 400 cubic yards of concrete for each. Though other work was performed a round the clock, concrete was placed during the daytime only.

Three forms were used; one being poured each day, a 48-hour form stripping schedule was applied. Once the concrete had attained a compressive strength of 1500 pounds per square inch, the form was collapsed and moved on rails through the other two forms and made ready for the next pour. The required compressive strengths were easily attained in less than 48 hours. (In the case of the ceilings, a compressive strength of 2500 pounds per square inch was required before the form could be stripped, and 58 hours were needed before this strength was attained.)

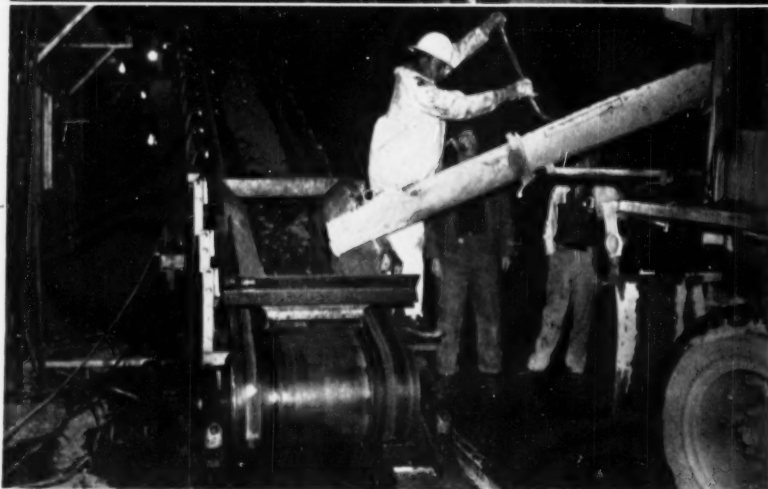
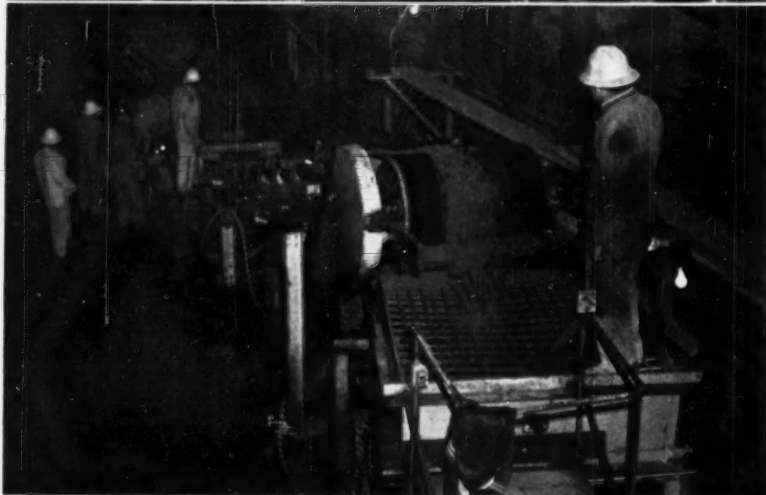
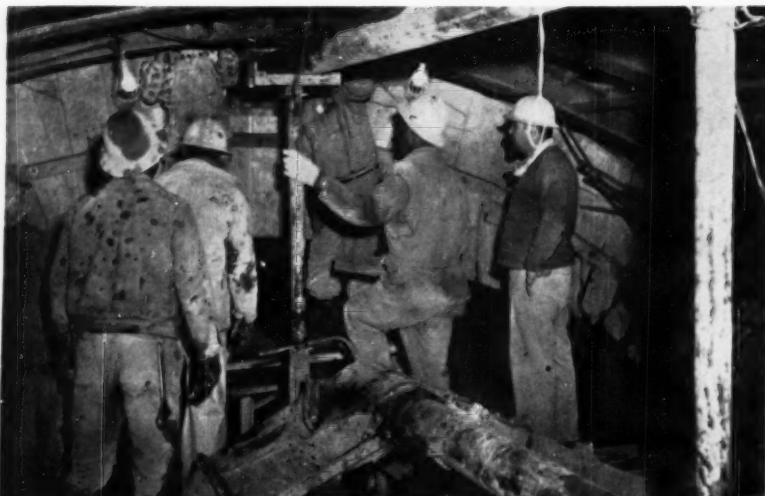
Placing concrete for tunnel linings requires special techniques involving the use of some kind of powered placing equipment. Concrete forming the sidewalls and arches of the Fort Pitt Tunnel was placed with pneumatic equipment manufactured by Pressed & Welded Products Company, Pittsburgh. It demanded that the concrete be forced through delivery pipes no greater in diameter than 6 inches.

The concrete mix was designed for the job by Merritt-Chapman & Scott in accordance with State Highway De-



CONCRETE FORMS

Three of these more-than-50-foot-long Blaw-Knox tunnel forms were used to pour Monolithic sidewalls and arches. The first form was poured, then the next two in order. While the concrete was setting in the latter ones, the first was stripped and moved on rails through the second two and made ready for the next pour.



CONCRETE ON THE MOVE

Concrete from transit mixers was placed on a conveyor (above) that carried it to a $1\frac{1}{2}$ -cubic-yard hopper of a pneumatic concrete-placing machine. Mounted on rails, the machine followed the forms as they progressed along the tunnels. Concrete comes off the conveyor and drops into the hopper (center). The machine placed 1 yard every 30 seconds through 6-inch-diameter delivery pipes (top). The concrete traveled as much as 90 feet from the trucks and was poured into the top of the Blaw-Knox forms.

partment specifications. Because placement with the pneumatic equipment required a minimum slump of 4 inches, the problem was to design a highly workable mix that would meet the strength requirements and at the same time would be within the State's strict water-cement ratio specifications.

Using Type IA (Pennsylvania Type C) air-entrained Portland cement, No. 2b crushed limestone, Ohio River sand (meeting Pennsylvania State Class A specifications) and 5 gallons of water per sack of cement, the mix produced a 3000-pound concrete with a 2-inch slump. Such a mix, however, could not pass through the placing equipment without clogging the slick lines.

The solution to this problem was found to be the use of a Master Builders Company admixture, Pozzolith, which when added to the mix produced a slump of $5\frac{1}{2}$ inches without exceeding the required water-cement ratio. Selection of the admixture came only after a series of exhaustive tests. Air content averaged 4 to 4.5 percent, increasing the density of the original mix 1 pound per cubic foot. In addition to increasing the workability, the Pozzolith formulation used also prevented the formation of cold joints and honeycombing by retarding the early rate of hardening as much as 60 percent during the 6-hour pours.

The ultimate specifications for the sidewalls and arches called for a highly fluid mix weighing approximately 146 pounds per cubic foot. Each cubic yard of concrete contained 587.5 pounds of cement, 1100 pounds of sand, 2020 pounds of No. 2b crushed limestone and $31\frac{1}{2}$ gallons of water. By heating the water and aggregate, 50- to 80-degree temperatures were achieved at the time of placing.

Intensive concrete testing procedures were followed at the site. Four test cylinders were molded at every pour, cured under job conditions and broken at 2, 7 and 28 days. Each barge of sand and aggregate was tested for gradation by Michael Baker engineers, while samples of all materials were sent daily to the State Highway testing laboratory at Harrisburg, Pa. The engineering firm of Michael Baker is the first ever retained by the Pennsylvania Department of Highways to perform all inspection functions on a State job. The department set a second precedent by using the admixture in the concrete tunnel lining to improve the workability of the concrete without reducing the required strengths.

The job is now more than three quarters finished. Merritt-Chapman & Scott's portion may be completed well in advance of its target date of February 18, 1960; the total work will undoubtedly be finished sooner than the planned September 1, 1960 opening.

Relocating Two Routes At Rocky Reach

PAT THOMPSON

BLEAK CONDITIONS

A chill wind from Washington's Cascade Range whips across a second-lift drilling location. This Crawl-IR completed its job, the holes were loaded, then the cliff was blasted to fall on the rail tracks below.



WHEN engineers put the final line to drawings of Washington State's Rocky Reach Dam, now under construction, they solved the need for more hydroelectric power but inevitably created other problems. For example, the 43-mile-long reservoir to be spawned upstream from the dam (located on the Columbia River 7 miles north of Wentachee, Wash.) dictated that many miles of highway and railroad must be rebuilt to avoid the man-made lake.

One such relocation involves State Highway No. 98 that parallels tracks of the Great Northern Railway northward from Wentachee. The two routes follow the Columbia for several miles then swing north into the apple-rich Okanogan River Valley, on up to the Canadian border. Portions of both the highway and railroad are being rebuilt as far as 41 miles behind the damsite. Work is being carried out in three sections.

The contractor for the first phase (6.4 miles of rail and 3 miles of highway) was Goodfellow Brothers of Wentachee. This section was completed in June and involved about 30 percent of the work, including much difficult rock drilling and blasting. The second and third phases are underway with Goodfellow Brothers and other concerns involved.

In working on the first stage, Good-

fellow Brothers dealt with three separate agencies—The Washington State Highway Department, the Great Northern Railway and The Chelan County Public Utility District (PUD). The PUD carried out condemnation of lands for the reservoir, in effect, trading land with the railway, providing a realignment of the present grade plus a cash settlement for the existing railroad facilities. The agency furnished a subgrade that met the Great Northern's specifications and the railway was responsible for the finished ballasting and laying of track.

The State Highway Department believed the new road needed to be im-

proved from class five (two lanes only) to class four (four lanes and 80-mph curves) because of heavy traffic on the route. (The Lake Chelan region north of Wentachee in central Washington is a rapidly developing recreation area and as many as 120,000 campers visit one area in a single season.) The difference in cost between the two classes of road was borne by the Highway Department.

During this first stage, three rights-of-way were used on a step-level basis at one narrow point between a cliff and the Columbia. This was typical of the challenging work. Because it was necessary to keep the rail traffic operating,

CLEARING RIGHT-OF-WAY

Taken from about 80-feet up, this view shows the removal of rock blasted down from the overhanging cliff. At the extreme right can be seen a small portion of the Columbia River.





DRILLING SITE

Three Ingersoll-Rand 600-cfm Gyro-Flo rotary compressors supply air to Crawl-IR units at this site along the relocation route. Trailer-mounted water tanks attached to the compressors provide water for keeping down drilling dust.

the rail bed was shoo-fled out into the river and a detour track laid. After it had been built to subgrade, the original railroad site was used for highway traffic. Then the highway was completed and the automobile traffic returned to it, at which time the railway was moved to its final grade.

The fact that railway service had to be continuous presented a coordination problem to the contractor. Daily, one train goes north to the Canadian border at 6 p.m. and returns 12 hours later. Rock blasted for the new grades occasionally fell directly on the tracks below and had to be removed by the time the train returned in the evening. Upon arrangement with the rail company, two experienced railroad men were posted at the work site and no blasting was allowed without their authorization. Normally about 2 hours of work were needed to clear each blasting round. Once, however, a large overhanging cliff couldn't be handled with the usual quick method because the overhang dropped too much rubble. The track was officially closed then for 12 hours.

In still another area, special difficulty was encountered in the primary drilling of rock that was seamed and fragmented for the first 20 feet of depth. This caused some drill sticking and prevented dust from blowing clear of holes. Here, although 350 to 400 feet of hole were put down during a 9-hour shift, drilling was much slower than at other locations.

The contractor's powder and drilling superintendent, C. "Mac" McCallister, had several anxious hours drilling next to an existing railroad tunnel. The set of holes being put down was to bring the highway to a level slightly below that of the top of the tunnel and only about 40 to 50 horizontal feet away from it. Because the rock aperture was not cased, a bad shot could have caved-

in the roof. Fortunately, the blast reacted as planned and the tunnel stayed intact.

Later this same railway tunnel was used as a detour for vehicles. The rail bed's grade was ballasted between the tracks then surfaced with a 3-inch lift of uncompacted cold asphalt mix. This allowed a single-lane of traffic to pass through the tunnel. Traffic lights were placed at ends for control and automobile movement was halted completely when two guards dropped gates at train time.

With his three Ingersoll-Rand Crawl-IR self-propelled tracked drilling units, the contractor used 1 $\frac{1}{4}$ -inch, 10-foot steels with 3-inch Ingersoll-Rand Carset bits, drilling on both 8x8- and 10x10-foot spacings. Normally, holes were put down 35 to 45 feet in an unusual combination of sandstone and basalt con-

taining igneous intrusions. The soft sandstone required special care and slowed drilling.

Air for the work was supplied by three Ingersoll-Rand Gyro-Flo 600-cfm rotary portable compressors, each capable of being towed by its Crawl-IR drill. An additional trailer-mounted tank was connected to each compressor. The extra tank, the same size as the air receiver on the compressor, contained 330 gallons of water. Air traveled from the compressor to the extra tank and thence to the drill, picking up water from the tank. Each drill operator had an individual control for the amount of water to be delivered. In drilling the second bench each drill used about 10 gallons of water hourly to keep dust down. Surface drilling required as high as 25 gallons per hour. Although the rock contained about 35-percent silicon, no dust could be seen rising from the work. It is reported that Washington State's Department of Labor & Statistics is studying this antidust technique as a possible statewide safety standard to protect drilling personnel.

As of a recent date, the Goodfellow Brothers blasting unit had used some 400,000 pounds of powder in shooting more than 700,000 cubic yards of rock. In drilling for this period, including considerable time for pioneering, breaking-out and for handling sandstone and fragmentary material, the I-R drills averaged 350 linear feet of hole per drill for each 9-hour shift. Most of the shattered rock was moved in 17-yard Mack trucks loaded either by a 2 $\frac{1}{2}$ yard Northwest or Manitowoc Shovel.

CHANGING STEEL

Steel is changed on this Crawl-IR, below, while at center background a worker loads powder. This operation is part of secondary drilling of a total 65-foot-deep cut.



Meat-Curing Process Aided By Compressed Air

J. F. KRAMBULE

BASED on the principles of pumping solutions under air pressure, the Simplex brine pump is now available for meat processing. It is used to pump a curing solution, or brine, into hams and bacon, guaranteeing a more constant and uniform quality in the meat.

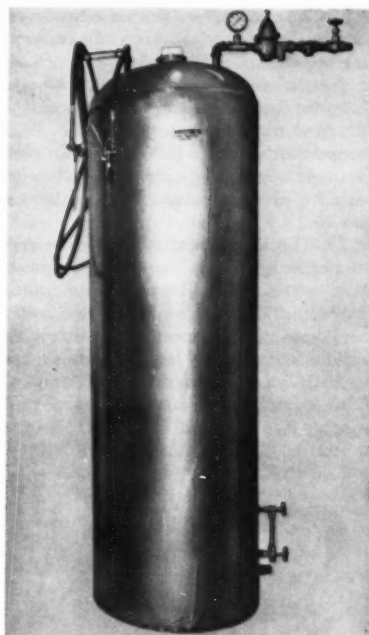
Invented by C. L. McWilliams of Ogden, Utah, and manufactured in the same city by Kobel Sheet Metal Products Company, the pump has won approval by the U. S. Department of Agriculture. Its principal component is an upright stainless steel tank that may be of a standard 20-, 40-, 75- or 150-gallon capacity. (Special ones can be built to meet customer specifications.) It is constructed of $\frac{1}{4}$ -inch, No. 316 stainless steel plate that will not corrode. Air intake piping and a valve-and-gauge assembly are on one side of the cylinder's domed top. Opposing it is the outlet piping, to which is attached hoses and injection needles. Near the base of the tank is a simple glass indicator gauge that registers the amount of contents.

By checking it, the operator knows when the tank must be refilled with brine. Beneath the gauge is a cleanout plug for easy draining and washing.

Installation of the pump is easy and economical: it requires no additional brine tanks and no platforms or other preparatory structure. The unit is portable, and outlet hoses may be extended to make possible simultaneous curing in several parts of a processing facility.

Operation

The brine is poured into the tank through a 3-inch opening in its domed top, and the container is then sealed tightly. Compressed air is applied at a pressure of 35 to 40 psig, forcing the brine through the outlet pipe and connecting hose into the injection needle. A long, perforated needle is inserted into a ham for stitch pumping; or, equally effective, it is placed directly into the large artery of the ham. The latter process, which uses a somewhat shorter



BRINE PUMP

Invented by C. L. McWilliams, this Simplex brine pump uses compressed air to force curing solution into hams and bacon. Air pressure is controlled by the valve assembly at the inlet side (upper right). The brine is forced through the outlet piping, hose and injection needle (upper left) into meat.

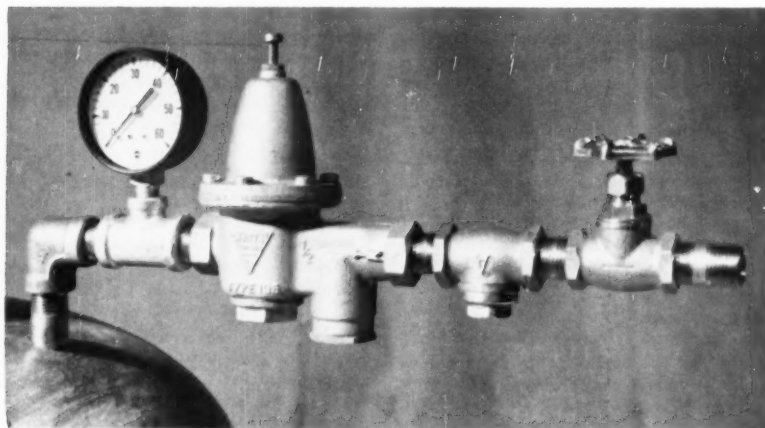
needle than the stitch pumping method, is called artery pumping and is usually considered preferable.

The curing process requires only one operator who first opens the air valve and then allows the brine to flow through the proper needle for a predetermined length of time—usually from 12 to 15 seconds when a pressure of 35 psig is used, or until the ham has received from 10 to 12 percent of its gross weight. The steady, even flow produced by the air pressure is responsible for the resulting uniform quality in hams; an uneven or pulsating pressure may break down the smaller vessels, leaving gray spots that are undercured.

Advantages

Curing with the Simplex pump is estimated to be 30-percent faster than conventional methods, and it eliminates mechanical failures for there are no moving parts to malfunction. There is no time loss due to repairs or replacing of worn parts, and no spoilage of hams due to these stoppages in production.

By lengthening the outlet pipe and attaching more hoses, multiple curing operations can be done simultaneously. One pump can accommodate from six to eight operations without any appreciable loss in pressure and resulting qual-



INLET PIPING

A close-up view of the inlet valve assembly. At the left is the pressure gauge. Next to it is a Watts regulator valve, and connected to it is the check valve and the air valve. Using this set-up, pressure in the tank is maintained constant, thereby assuring uniform, high-quality hams.

ity in the meat. A simple adjustment on the air regulator valve compensates for the additional outlets.

Operation is sanitary since all the brine is sealed within the tank and is pumped directly into the ham. With conventional methods, the brine is often pumped from an open tank through equipment that is not covered or encased.

The tank offers another convenience and money-saving factor—the use of hold-over brine. While there are a number of brine mixtures being used in the meat-curing field, most of the newer solutions contain the highly unstable and easily oxidized ascorbic acid Vitamin C. This substance is often rendered inef-

fective when left in the conventional open tanks, but may be kept for use the following day in the sealed tank of the Simplex pump.

Mixing of the brine is of little concern in the new method; ingredients may be poured directly into the tank, a small amount of air pressure applied, and soon the brine is thoroughly mixed. The intake pipe, which extends almost to the bottom of the tanks, serves not only as the initial mixer, but keeps the substance free from settlings throughout the operation.

The Simplex pump for this application has just recently been put on the market. A specially built model has been in use for 12 years at the W. C.

Parke & Sons meat-packing plant in Ogden. During that time, the pump is reported to have operated efficiently and without failure. After about 4 years, the galvanized iron tank that was first used had become corroded and was replaced with a stainless steel one. This was the only time down for repairs.

While greater speed and lower production costs are all important to the processor of meat products, the Simplex pump offers something even more important—dependability. The result is a smoothly operating process free from mechanical headaches. By using compressed air, cured hams and bacon of unfailing and uniform quality are produced.



This and That

October Drilling Symposium Penn State University October 8-10. Sponsored jointly by the departments of mining engineering at the University of Minnesota, Colorado School of Mines and Penn State, the conclave will be the ninth annual drilling symposium held since its inception at Minnesota in 1950. Five technical sessions will have as their subjects: statistics and operations research in exploration, bit design and rock penetration, improving core recovery, drilling and sampling of unconsolidated materials, and innovations and case studies in drilling practice. The program will be of interest to engineers, geologists, contractors and operators.

★ ★ ★

Once reserved for the Red Carpet princes of metals with Melting exotic names, consutrode Treatment (consumable electrode vacuum) melting is now being accorded with unusually good results to the commonplace low-alloy steels. Steels thus produced are cleaner, stronger and more dependable. Most of them are being used in aircraft and missiles, for gears, shafts, bearings, valve springs, piston pins and the like. In the consutrode melting, air melted electrodes of closely controlled composition

and premium quality are consumably remelted by means of an electric arc in a copper, water-cooled crucible. A vacuum draws off gases and volatile impurities. Nonmetallic inclusions are dispensed and floated to the ingot hot top. With the consutrode method of remelting, large ingots ranging from 13,000 to 15,000 pounds are available; there is a minimum of segregation, especially in alloys containing high-density elements. Because of the rapid solidification, mechanical soundness of the large ingots is better than with conventionally cast, induction vacuum melted materials. Users find that initially higher costs involved, as compared with other melting processes, are more than offset by the high, certain quality of the parts produced. Low alloys now have better transverse ductility and fatigue strength, and improved fabricating characteristics in such severe spinning operations as Flow-turning and Hydro-spinning.

★ ★ ★

"European Technical Digests" The advantages of being able to read at a glance the latest technical developments without subscribing to hundreds of foreign journals are obvious. A monthly publication called *European Technical Digests* makes this possible. To publish the journal, the European Productivity Agency searches more than

1000 technical journals appearing in thirteen countries and in eleven languages. Engineers check new methods, apparatus and materials that could be used in industry without large capital investment. The results are condensed and published in English. The purpose of the digests is 2-fold: to spread technical information irrespective of language barriers; to cross-feed ideas from one industry to another. Although the publication covers the glass, chemical, leather, textile and lumber industries, it deals principally with all engineering and equipment, and metallurgical and agricultural machinery. Importance is attached to general industrial subjects such as corrosion, materials handling, packaging, safety and management. The success of the publication has induced countries to publish translations so that, as well as English, it appears in German, Italian, Norwegian, Spanish, Turkish, Croat and Japanese, and on a selective basis, in Hebrew and Icelandic. Greece and the Netherlands issue translated title lists. As a free readers' service, the European Productivity Agency supplies photocopies of the original articles, as well as additional information wherever possible. *European Technical Digests* is not expensive, however. It costs only \$12 a year; a 6-month subscription, \$6.

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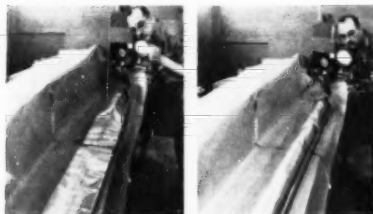
Anocote Protects Aluminum Harvey Aluminum has perfected a process to protect extrusions. Called Anocote, the development eliminates superficial corrosion of aluminum. Special production operations and metallurgical techniques are required for the Anocote treatment. Because the process protects the metal during routine shipping, storing, and handling, fabricators who anodize or etch their extrusions report that the surface of Anocote aluminum is exceptionally smooth, uniform, and free of defects after anodizing or etching. Anocote is

being offered as a company service, enabling aluminum manufacturers to produce a better product, reduce production rejects, and simplify storage practices. This appearance of the finish does not alter the natural color of aluminum, and it may be used as the final surface of the metal.

★ ★ ★

Inflatable Metal Tubing

Experimental production of light-wall seamless metal tubing that can be shipped in ribbon form and inflated at the point of use will start this fall. The material is to be known as Strubing (from strip tubing) and may be useful in industries as diverse as general and chemical manufacturing, construction, electric power distribution, communications, rocketry, farming and packaging. Calumet & Hecla researchers, who are developing the special tubing, report that two major



advantages will be gained from its use. First, point-of-use inflatability makes it possible to ship the thin-wall tubing economically—only the tube walls and not the inside hole are shipped. Second, the cold rolling process used in making Strubing provides an economical means of producing tubing in thicknesses either unavailable today or too costly to be practical. Air pressure, as well as hydraulic and mechanical means, have been applied to inflate the thin-wall components. In the picture shown here, water is being used.

★ ★ ★

Hose Without End

A continuous production process developed by Goodyear Tire & Rubber Company will be of special interest to the chemical and petroleum industries. With it, large-diameter hose without splices and in lengths limited only by the size of transportation facilities to handle it can be manufactured. Although the new process is a secret, the nonstop system turns out its product with a liner that is wrapped and sealed on a mandrel, wrapped with reinforcing cord, bagged and cured in a continuous cycle. The process resembles that used in making automobile tires. Although the first hose was produced only in 500-foot-lengths

for military projects, it is said that immediate demands for it will come from companies concerned with unloading tankers from off shore, off-shore drilling production, industrial waste disposal and temporary pipelines. The new hose can be manufactured to float or sink for marine use, and to handle all known chemicals and fuels. At present, hose producible ranges in inside diameter from 2 to 8 inches.

★ ★ ★

Celestial Hide-And-Go-Seek

The defensive tactics of hiding vehicles in outer space is one of the advanced research products scheduled for Republic Aviation Corporation's new multimillion dollar Research & Development Center, Farmingdale, Long Island, N. Y. The so-called hiding of space vehicles would be done by making them nonreflective. Studies of this technique will be made in an anechoic (anti-echo) chamber whose complex model mounts will be built by ANTLAB, Inc., Worthington, Ohio. The chamber will be a part of Republic's new electronics laboratory.

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Jet-Fast Luggage Handling

Passengers in jet liners shooting across the sky at 600-odd mph become accustomed to speed; when they arrive at their destination they want their luggage in a hurry. To fill this need, strong but lightweight containers have been developed to remove luggage from the aircraft in less than 3 minutes. The containers are made of rigid urethane sandwiched between fiber glass and weigh only 84 pounds, although 1100 pounds can be carried in them. Designed for the DC-8 jet, the containers are carted to the plane then lifted aboard by an electric hoist. Inside they fit into place on a track, much like beads on a string. The hoist and positioning mechanism are integral parts of the aircraft. Eleven of these containers are carried in the Douglas jet and each holds about 25 bags. They eliminate piece-by-piece handling of luggage and cargo, and keep jet-age passengers content.

★ ★ ★

Anticipated Construction For 1970's

The total volume of construction in the United States, estimated at about \$73 billion for 1959, is expected to exceed \$107 billion in 1970 (in terms of the 1959 dollar) according to a long-range study made by The Associated General Contractors of America. This will represent an increase of about 48 percent over the next 11 years in

the amount of work put in place by America's largest industry. Construction activity now accounts for approximately 15 percent of the gross national product, and for a similar percentage of total employment, directly and indirectly. By 1970, the construction industry's annual requirements are expected to reach 435 million barrels of cement (306 million barrels was the estimated figure this year), and 5,431,000 tons of fabricated structural steel, as compared with about 3,993,000 tons in 1959. The AGC said that the figures projected in this study were based on definite trends and programs that can be used in anticipating construction volume, and were conservative estimates. Of the anticipated total volume of more than \$107 billion in 1970, new construction is expected to account for about \$79 billion and maintenance and repair work for some \$28 billion.

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Titanium Stamped Approved

Unalloyed grades of titanium (1, 2 and 3) of ASTM Specification B265-58T have been approved by the American Society of Mechanical Engineers for welded pressure vessels. Grade 1 is a high-purity, low-strength grade that is usually specified when corrosion resistance and high ductility are required. Grades 2 and 3 correspond to Crucible Steel Company's standard grades A-40 and A-55, respectively. In the past, special approval was required for each unit if the vessel required code approval.

★ ★ ★

Cases-In-Metals Standards

Eight bars of ferrous materials, whose oxygen and nitrogen content have been precisely determined, comprise a new type of standard sample available from the National Bureau of Standards. (More than 600 standard samples of chemicals, ores, ceramics, metals and other substances are available from the organization.) These reference materials, approximately 3 inches long and 1 inch in diameter, are necessary for the calibration of chemical analytical equipment used to measure the gas content of various kinds of commercial steels. Low gas content is a characteristic of metals with desirable properties, and the acceptable amount of gases present in a metal is generally stipulated in procurement specifications for metals and metal producers. The eight bars are available upon payment of a \$10-per-sample fee. A certificate of analyses accompanying the materials lists the laboratories that have cooperated in this effort and the various methods that have been utilized to determine the gas content in the metals.

The Bureau's chemical metallurgy laboratory utilized a vacuum-fusion method to analyze the new samples. A small furnace, containing a graphite crucible, is connected to a vacuum system by means of a vertical tube. When the furnace has been heated, to a temperature of about 2900° F for steels, the metal sample, which had previously been

placed inside horizontal side arms connected to the vertical tube, is maneuvered with a magnet until it falls into the hot crucible. As the sample melts, the gases liberated by the reaction of the graphite in the crucible are collected for analysis. The oxygen thus obtained is evaluated as carbon monoxide, and the nitrogen as molecular nitrogen.

In making the present standards available, the Bureau has inaugurated a program for providing gases-in-metals standards for a number of metallurgical products. Work is now in progress to develop standard samples for gases in titanium to meet the increasing demand for such standards imposed by their use in space vehicles.

Project: To Measure Density Drag

MAN may soon learn the exact density of the upper atmosphere by means of information relayed to earth from a unique balloon ejected from a 2-stage rocket. During the past year, Arthur D. Little, Inc., a research and engineering company in Cambridge, Mass., has overcome complex problems involved in the design of the device. As a research project for the Geophysics Research Directorate of the Air Force Cambridge Research Center, Bedford, Mass., the consulting company developed an inflated sphere with instrumentation and a telemetry system. The purpose of the experiment is to measure

density drag in previously uncharted areas of the layers of air surrounding the earth and 300 miles away.

First stage of the flight will be furnished by an Aerobee research rocket. The second stage, a solid propellant Sparrow rocket, will soar to the 300-mile range.

About 60 miles up, well above the burnout point of the Sparrow, a timed signal will trigger the rocket's mid-section, causing it to fold at a 90-degree angle. This will reduce the spinning motion. Another signal will eject an 18-pound package through a door in the rocket's shell. Upon release, the

package will blossom into a 9-foot Mylar plastic sphere, reinforced with Dacron threads.

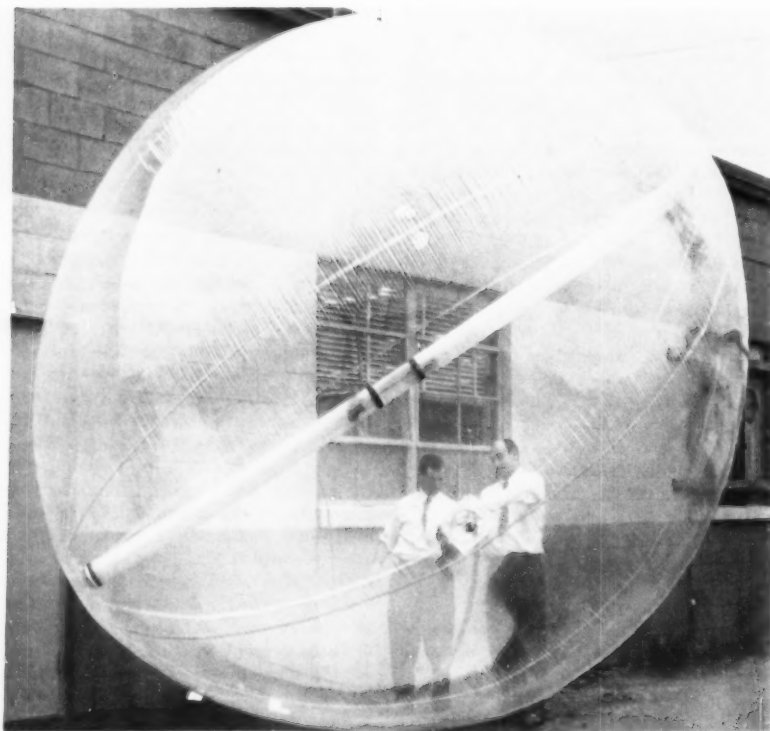
As the balloon is freed from the rocket, it will closely follow the trajectory of the projectile up to the zenith of 300 miles. Arthur D. Little engineers have calculated that this free flight of the balloon will take between 7 and 8 minutes. During the time, valuable information will be continuously recorded on instruments below.

To inflate the sphere, engineers found that evaporating ethyl alcohol would do the job the simplest way and at a low pressure. A small capsule containing freon gas at a higher pressure will discharge into a hollow plastic strut inside the balloon. At mid-point of this strut will be an aluminum can containing instruments to record and transmit data to earth.

At the instant the ejection takes place, a radio transmitter within the can will begin sending signals to a ground station. Information transmitted will note the amount of drag induced by the rarefied gases in the upper atmosphere acting upon the surface of the experimental balloon.

A special accelerometer is the heart of the instrument package. It was designed by the University of Michigan and further modified by the Air Force Cambridge Research Center to measure to a one hundred thousandth of a gravity. It has proved itself in a 7-inch aluminum sphere where it provided density measurements in distances of about 80 miles above the earth.

Heading the project for A. D. Little is 36-year-old, chemical engineer David Lull of Lexington, Mass. His experience is in the field of rocket propellants. Aiding Lull are Theodore J. Nussdorfer, Jr., 38 and also of Lexington, who is skilled in rocketry; and David A. Knapton, 32 of Needham, Mass., a mechanical engineer. The project team is complemented by Lt. R. W. Procnier, project scientist from the AFCRC's Photochemistry Laboratory of the Geophysics Research Directorate, and William Hawkins, a member of the Wentworth Institute Staff, Boston, Mass.



LEADER, ENGINEER AND SPHERE

The Mylar balloon shown will contain instrumentation and telemetry systems. It will be ejected from a 2-stage rocket to measure density drag of the atmosphere as high as 300 miles. Inflating the balloon are D. A. Knapton, a mechanical engineer and aid to D. B. Lull, who heads the project.

Industrial Gases



UNIVERSAL is the air around us, but unless we take time to think about it, many of its ramifications are lost. For centuries, the mystery of air was a matter for speculation. Only that it sustained life and supported combustion were known until men like Rutherford, Priestley, Wroblewski and Olszewski unlocked some of the secrets. Their work, in the eighteenth and nineteenth centuries, identifying the components of air would have remained scientific curiosities had not the then infant "supporting industries" been ready to keep pace. It is to these industries, now grown and still keeping stride, that today's manufacturers of industrial gases owe an important share of gratitude. Without the supporting manufacturers, the constantly increasing output of industrial gases, at costs that are still reasonable, would have been impossible.

Any discussion of gases must first give thanks to the makers of compressors. It is the air compressor that initiates many of the manufacturing processes: the same air we breathe is compressed, then purified, cooled and separated into such gases as oxygen, argon, nitrogen, xenon, krypton and neon. Acetylene, hydrogen and helium, industrial gases obtained by different means, rely upon compressors for their role in production, handling and bottling techniques.

How important are the industrial gases, and in what fields are they needed? These questions are often raised. Production statistics indicate that they are of great importance.

NEARLY 75 years ago, the use of oxygen was confined almost entirely to magic-lantern spotlights in Victorian theaters. Daily output was measured in a few hundred cubic feet. Now, serving industry and medicine, oxygen is turned out in daily quantities that approach 200 million cubic feet. In 1958, for example, 38,042 million cubic feet of 99.5-percent-pure oxygen was produced, along with 25,655 million cubic feet of a lower purity oxygen (95 percent). Oxygen steel making and oxy-acetylene welding, cutting and treating of metals consumed the majority of the gas.

To protect welds from atmospheric contamination or oxidation, argon finds its most important application in gas-shielding. Brazing is another use, as is the manufacture of incandescent lamps and fluorescent tubes. The 1958 demands required the production of some 372 million cubic feet of argon—a reported increase of 6000 percent in a little more than a decade. Once considered a rare gas (constituting only

0.94 percent by volume of the earth's atmosphere) improvements in technology and in production and compression equipment have made quantity output economical.

IN THE white heat of an electric-arc furnace, a mixture of coke and limestone is converted into calcium carbide. With the addition of water to this gray rockish substance, acetylene is generated almost exactly as it was when discovered in 1892 by Thomas L. Willson. The gas formed makes one of the hottest (6000° F) flames available, and when complemented with oxygen, forms oxy-acetylene that is used for metal working, not only in large factories but in millions of homes as well. An important gas? Last year, acetylene production was rated at 10,696 million cubic feet. This hydrocarbon makes a superior building block for the chemical industry, and some of the 1958 production went into the plastics industry for neoprene insulation and industrial belting, flexible vinyl plastic for hoses, and rigid plastic for stereophonic records. Acetylene has come a long way from its earliest use in automobile headlamps.

HYDROGEN which is contained in small quantities in the atmosphere, is manufactured in different ways than by liquefaction and separation methods used for nitrogen, argon and oxygen. Hydrogen is formed chiefly by passing electricity through water or by reacting natural gas. It is used in food processing, as a fuel and in such metal-treating applications as low-temperature brazing, and the welding of aluminum, magnesium and lead. A growing use has been in the production of tungsten and molybdenum. In agriculture, a principal application is in hydrogenation of soy bean, fish, corn and cotton seed oils in which the oils are changed into solid compounds of higher melting points. Another basic in the chemical and petrochemical industries, hydrogen production last year was exceeded by oxygen. The total amounted to 43,075 million cubic feet, exclusive of the volumes used in the manufacture of ammonia and methanol.

INDEED industrial gases have come a long way from Rutherford's identification of nitrogen in 1772. New uses are being found daily and the quantities of the gases needed for present applications are constantly increasing. Thanks in part to the compressor manufacturing industry for keeping pace with the demands of the industrial gas industry, these needs will be met, contributing significantly to our well-being.



SAVING WITH AIR POWER

Application: Swift-Moving Air

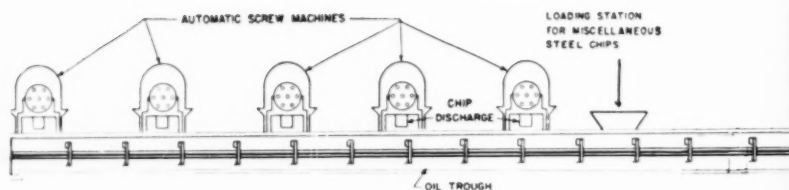
MAKING USE of blowers that force air through ducts at hurricane speeds, The National Conveyors Company, Inc., Fairview, N. J., designs and builds conveyors to automatically carry metal chips and borings from manufacturing plants.

The Chipveyor systems vary in length from 100 to 2000 feet, depending on the distance the turnings must be transported. Conveyors, crushers and oil reclamation equipment take the chips directly from the metal-working machines producing them. Larger pieces of tramp metal and solid scrap from the machine tools are rejected before the turnings move to the crusher to be reduced to uniform size. This crushing operation also increases the scrap value of the turnings by approximately \$4 per ton.

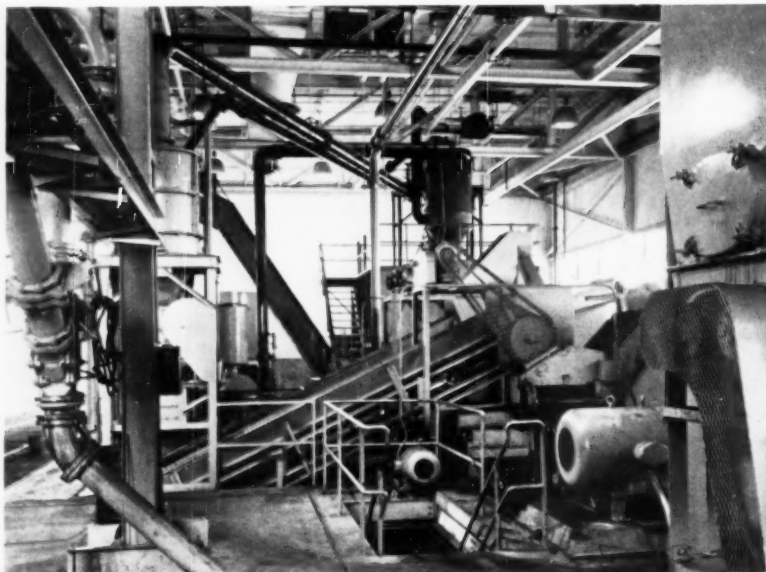
The next operation, reclaiming of oil from the chips, is done automatically by a continuous centrifugal oil extractor which recovers approximately 40 gallons of oil per ton of chips. At \$0.40 per gallon, this is a savings of \$16 per ton. After the oil has been recovered, the chips are discharged into a hopper that feeds them into the Chipveyor duct. The blower air sweeps them along at 90-mph, either directly to railroad cars or to storage bins for gravity loading of train cars or trucks. The blower is an electric-motor-powered unit.

Several additional savings and advantages are gained from the automatic air conveyor system. Time studies have shown that manual trucking of turnings to ground storage bins or trucks requires about 3 man-hours per ton. At a labor rate of \$2 per hour, \$6 is spent in moving each ton of chips. With the air unit the job is done automatically, permitting workers to be put on other production or maintenance jobs.

Another important benefit is that shop floors and runways are cleared of spilled turnings and the inevitable oil drippings that accompany them. This saves housekeeping costs as well as improving general plant appearance. At one installation, the conveyor was credited with an annual saving of \$7800 normally earmarked for housekeeping. Use of the Chipveyors also eliminates fire and injury hazards which are present when oily machinings are handled manually.



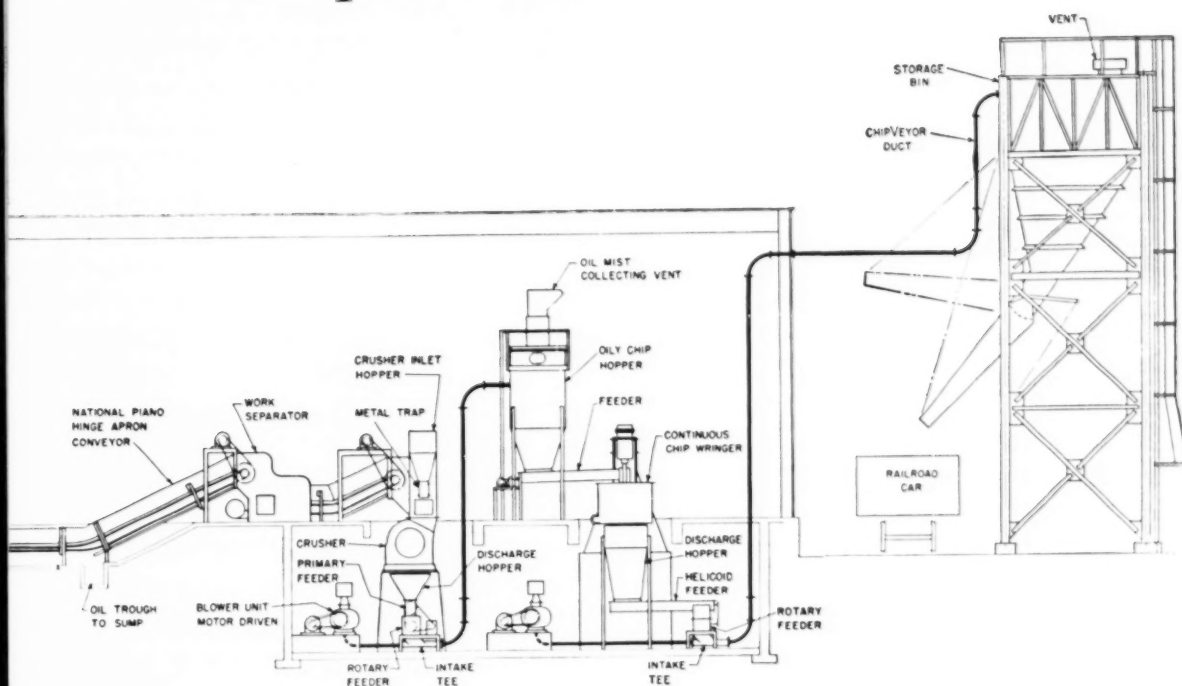
Complete circuit of conveyor system is shown in this drawing. Chips pass from machine to conveyor that takes them to separator, crusher and wringer. Final discharge hopper feeds chips into duct, blower air whisks them to storage bin. Rail car is filled by gravity from bin spout.



INNER WORKINGS

The apron conveyor slants upward in this picture, emerging from trench inside chip room. This conveyor feeds the chips into the work separator being driven by belt from an electric motor. When later fed into the conveyor duct, the chips are moved at 90 mph by blower air.

Solves Chip Problems



Three methods of filling railroad cars with chips. Immediately above, a storage bin retains chips until they are put into cars with spout. Upper left, Chipveyor duct goes from plant to rail track; track at left has been laid close to plant. Also some systems use trucks for hauling.



Industrial

Notes

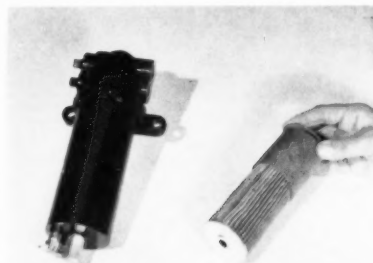
TEN years of rotary field experience have preceded the 125-cfm Gyro-Flo portable rotary compressor introduced by Ingersoll-Rand Company. Smaller and more compact than the manufacturer's original 125 cfm, the compressor reportedly retains the proved Gyro-Flo



features and has many new ones that are the result of extensive research, performance evaluation and customer suggestions. Features listed by the manufacturer for the Gyro-Flo 125 are: simplified, more efficient compressor system; automatic drainage of oil from cylinders when unit is shut down; larger, more-powerful engines; slower speed; safety shut-down on compressor; provision for inspection of all rotor vanes; fuel and air tanks located under housing and lockable cover; safely out-of-way, fold-back side covers; full-length tool boxes with more storage capacity; and 60-inch track for greater stability on rough terrain. The new portable is 10 feet 1 inch long, including drawbar, 5 feet 1 1/2-inches high, 5 feet 8 3/4-inches wide and weighs 2442 pounds ready to run. Power for the new 125-cfm size is supplied by 1800-rpm Continental Red Seal engines, gasoline or diesel. The unit is available

with 2-wheel mounting, or without running gear for truck or skid mounting. Ingersoll-Rand Company, 11 Broadway, New York 4, N. Y.

MICROPLEAT, a filter that removes dirt, water and oil from factory air lines, is available from Bendix. The No. 571000, as it is designated, was developed especially for precision air gauge applications where positive removal of foreign matter is basic for proper gauge functioning. The assembly consists of an aluminum filter head that houses inlet and outlet ports, a chemically coated



aluminum bowl with a drain cock and a Micropleat filter element. Four standard 1/4-inch pipe threaded parts, two inlet and two outlet, make for versatile mounting of the assembly. The housing will withstand line pressures to 125 psig.

BROKEN handwheels of globe and gate valves on air compressor manifolds proved a major problem to Morrison-Knudsen Company at Noxon Rapids Dam Site, Noxon, Mont. Handles broke when bumped with heavy objects; some were twisted off by workers. Cement spilled on the valves and made their operation difficult. In short, the average service life of the valves was only 2 weeks, and when they lost their handwheels, the entire manifold had to be taken to the repair shop—all costly down time for the contractor.

To solve this problem and bring costs back into line, 150 Grinnell-Saunders 2401-1-T diaphragm valves were installed on all compressed air manifolds. They have now been in service for a year and a half. During the time, not a single handwheel has been reported broken and none of the neoprene diaphragms have required replacement. Furthermore, these valves, which close airtight, operate easier.

Due to the abuse that the valves are able to withstand on this rugged construction service, there is virtually no maintenance. Comparing the service life of the formerly used valves with the Grinnell-Saunders units, a major and costly problem on a vital job has been solved.

Spotlight on Valves

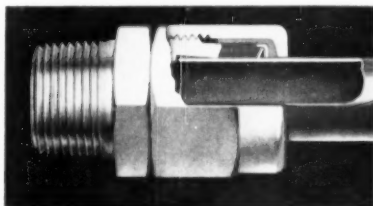


Rated flow for the assembly is 15 scfm at 100-psig pressure. The filter element is a pleated, phenolic-resin-impregnated cellulose cylinder with a deflector baffle around the top of the element. Rated at 10 microns, this element is said to be efficient in water and solids removal with a minimum increase in head. Flow in the filter element is from outside to inside. A spring maintains pressure on the seal between the element and the filter head. The assembly measures 9 $\frac{7}{8}$ inches in over-all length; the filter head has mounting holes on 4 $\frac{1}{8}$ -inch centers. A nut on the bottom of the filter bowl can be loosened to provide quick disassembly. *Bendix Aviation Corporation, Bendix Filter Division, 434 W. Twelve-Mile Road, Madison Heights, Mich.*

WELDING supplies and accessories are catalogued in a 51-page booklet that lists equipment for both arc and gas welding. More than 100 illustrations help explain a complete line of fluxes and ferrous and nonferrous rods for gas-welding; and accessory items include protective clothing, goggles, electrode holders, sparklighters, cable, hose, weld cleaning tools, cylinder trucks, etc. The booklet is designated Form ADC 848C. *Air Reduction Sales Company, Division of Air Reduction Company, Inc., 150 E. Forty-second Street, New York 17, N. Y.*

RUBBERNEK is a flareless, vibration-absorbing fitting that overcomes the major cause of tube connection failure. Developed especially for pneumatic and hydraulic systems, the design affords a leakproof joint yet permits tube movement, even where tubes are misaligned. The fitting provides a positive seal at high, medium or low pressures; can be reconnected repeatedly without wear or damage; and meets or exceeds JIC standards. A "positive stop" prevents mistorquing the fittings and is said to assure proper installation without special tools,

The chief design feature of the Rubbernek is its cushion unit that is furnished completely assembled. The simple in-

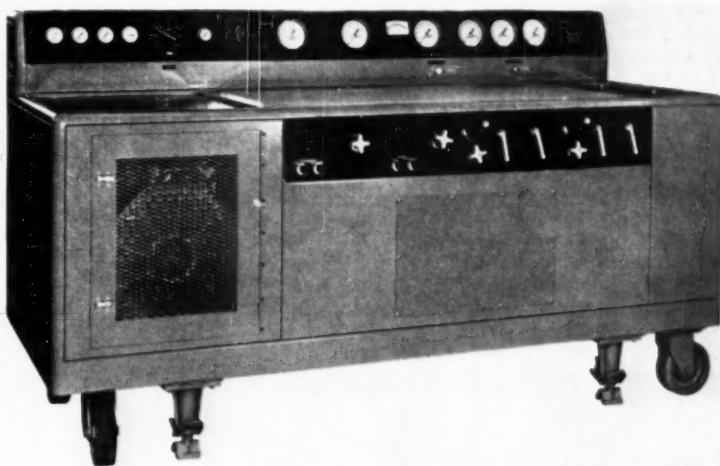


stallation, and absence of need for flaring, presetting or welding, soldering or other tube preparation, are said to make

possible important cost savings. Tests that subject the units to conditions more severe than those encountered in normal service reportedly have proved the fittings can hold pressures beyond the burst strength of the tubing. *Chicago Forging & Manufacturing Company, 2000 N. Southport Avenue, Chicago 14, Ill.*

TO illustrate the trend toward cranking internal combustion engines with air power, Ingersoll-Rand has prepared a 24-page bulletin about Air Starting Motors, Form 5094E. The bulletin contains case histories of Air Starting Motor

PNEUMATIC TEST STAND



This portable test stand is a self-contained unit designed to simulate high-pressure pneumatic systems for testing precision components, such as missile attitude controls. It can deliver 15 cfm of dry air at 100° F at pressures continuously variable from 0 to 5000 psig. Built by the George L. Nankervis Company, the stand has three separate gauges for progressive accuracy of measuring pressure throughout the full discharge range. The unit has desiccant driers to take moisture from the air, and there is a special fixture plate for mounting test components.

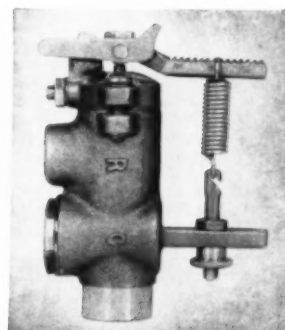
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CONRADER'S REBUILT UNLOADER VALVE REPLACEMENT SERVICE



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BOX 924 • ERIE, PA.

installations, gives information on how to select the proper Air Starting Motor, and lists advantages of these units. It provides detailed specifications and mounting-dimension diagrams for two new Ingersoll-Rand Air Starting Motors

Size 3BM and 10BM — as well as for Sizes 5BM and 20BM, thus providing information on the complete Ingersoll-Rand line. Drawings show piping arrangements for each size and a suggested hook-up for using the motors on vehicles. A 9-page selection list indicates the size and model number of the Air Starter required for starting most models of the diesel, gasoline, natural gas, or dual-fuel engines of 29 leading motor manufacturers. The bulletin may be obtained by writing the manufacturer, *Ingersoll-Rand Company*, 11 Broadway, New York 4, N. Y.

A SELF-CONTAINED air- or gas-powered instrument drive and timing unit is offered for use with instruments having chart record periods of 1 hour to 30 days. Used as either original or replacement equipment in the various types of recording instruments, Gaslok power drive, as it is called, is said to deliver power output of more than twenty times that supplied by conventional spring-wound clock mechanisms. The device has been designed and field tested

for operation in remote installations. It is self-starting, explosion proof and internally sealed to prevent corrosion or clogging. All parts exposed to gas are



made of aluminum or stainless steel. The timing spring is rewound once each 5 seconds to eliminate fluctuating torque, and the clock accuracy reportedly is not affected by wide fluctuation in supply pressure. The instrument has an air or gas consumption of 5 cubic feet per hour at its normal operating

pressure of 5 psig. Gaslok can be used on such instruments as strip chart recorders, integrating orifice meters, gas lift meters, pressure recorders, tele-counter units and field program timers. *American Meter Company*, 920 Payne Avenue, Erie, Pa.

PO-KO-NO is an open-center bench vise that offers a new design. While built to take the same loads as ordinary heavy-duty vises, this one features a construction whereby there is no obstruction beneath the vise jaws. Consequently, a variety of jobs can now be handled vertically as well as horizontally. The device also has a quick-change mechanism enabling the worker to set and maintain jaws at a predetermined position. Pieces of the same size may then be clamped and released from the jaws with a simple flick of a cam lever, representing a considerable time savings in multipiece operations. Three sizes are available: 3-inch jaws with a maximum opening of 5 inches; 5-inch jaws with 9-inch openings; and 6-inch ones that open to 10 inches. *Stroudsburg Engine Works, Inc.*, Stroudsburg, Pa.

THREE hundred fifty percent faster rundown and 25 percent more power are characteristics of a new 1-inch drive

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YOUR BEST BUY IN BEARING BRONZE

BEARIUM METAL outperforms all other bearing materials even under conditions involving poor lubrication, high speed, heavy load, high temperature or gritty surroundings... all without seizing or scoring the mating surface. BEARIUM METAL'S amazing superiority is due to the uniform dispersion of microscopic lead particles within the copper-tin grains rather than between the grain boundaries as found in ordinary bronzes. Try it on one of your toughest jobs... and be convinced!

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air Impactool, the Size 434. The direct drive between motor and hammer of this Ingersoll-Rand unit takes maximum advantage of inertia of rotating parts. Main application for this tool is for heavy truck wheel work and spring U-bolt jobs. The Size 434 is $10\frac{1}{8}$ inches shorter and 9 pounds lighter than the previous model. The lighter weight and reduced size enable a mechanic to work in tight spots where full power is still required. The 434 Impactool's simplified design has 25 percent fewer parts. This automatically reduces maintenance and repair costs. Further, the tool uses one third less air when impacting, enabling shops to run more tools from the same compressor. According to the manufacturer, the impact mechanism in the 434 gives maximum efficiency. The full inertia of the rotor, the hammer and the hammer jaw are applied to each impact blow. The Size 434 has a built-in, calibrated power regulator with four positions to permit the operator to regulate the power for lighter jobs. Other features include a simple push-through reverse valve, a graduated action throttle valve, Multi-Vane motor, and a side



spade handle that may be positioned either parallel or at right angles to the tool axis. The hammer case may be rotated 90 degrees in either direction, giving the operator a wide choice of locations for the side spade handle. At 120-psig air pressure, the 434 Impactool runs with a free speed of 3200 rpm and delivers an average of 1250 impacts per minute. Weight, less socket, is $23\frac{1}{8}$ pounds. The length, to shoulder of the square driver, is $15\frac{3}{4}$ inches, and the side-to-center distance, $2\frac{1}{8}$ inches. Ingersoll-Rand Company, 11 Broadway, New York 4, N. Y.

A SIMPLIFIED explanation of the basic principles of ultrasonics is contained in a 12-page booklet entitled *Tips on Ultrasonic Cleaning*. There also is a brief description of the generating equipment and transducers required for such cleaning, a discussion of proved applications, and a list of seventeen of the most frequently asked questions about ultrasonics complete with appro-

priate answers. The booklet is available free. Circo Ultrasonic Corporation, 51 Terminal Avenue, Clark, N. J.

SMALL $\frac{1}{4}$ -inch air drills having power and speed usually associated with drills twice their size are made by Ingersoll-Rand Company for production work. Since the new drills weigh approximately $1\frac{1}{2}$ pounds and are just slightly longer than a fountain pen, it is said that they can be handled easily and quickly on assembly lines. Applications for the units include production drilling in industrial, electrical, electronic, automotive, aviation, machinery, metal and

woodworking fields. The Triple O drills are available in five speeds, ranging from



4500 to 500 rpm at 90-psig air pressure. Chuck runout on the drills is less than

NEW SILENCER for air exhausts



High noise levels are effectively reduced by a new silencer developed by Air-Maze Corporation. Fits directly to exhaust ports or piping. Breaks up shock waves to attenuate objectionable noise without noticeably impairing efficiency

of air operated equipment.

Standard sizes for $\frac{1}{8}$ "- $\frac{1}{4}$ "- $\frac{3}{8}$ "- $\frac{1}{2}$ "- $\frac{3}{4}$ " pipe sizes.

Write for details in Bulletin KK-657, Air-Maze Corporation, Cleveland 28, Ohio. Department CA-9 (Subsidiary of ROCKWELL-STANDARD Corporation)

AIR-MAZE

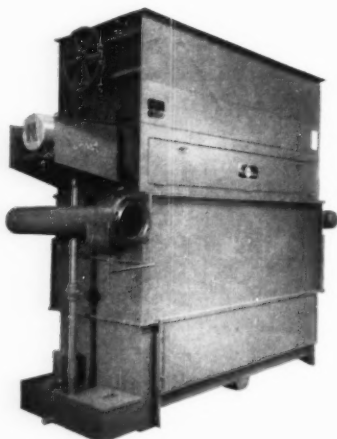
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How to get drier or cooler AIR or GASES at low cost

NIAGARA AERO AFTER COOLER cools a compressed gas, or air, below the temperature of the surrounding atmosphere, thus preventing the condensation of moisture in your lines. The gas will contain only half of the moisture left in it by conventional methods. Even drier gas can be produced if you require it.

In working with controlled atmospheres of inert gases to prevent undesired reactions, this dryness of the gas at low cost is a great advantage. The cost of the Niagara method is low because it uses evaporative cooling, saving 95% of the cost of cooling water (and its piping and pumping). This direct saving of cost pays for the Niagara cooler in less than two years.



If you use compressed air to operate instruments or pneumatic equipment you will get better results by using the Niagara Aero After Cooler.

Write for Bulletin 130, or ask nearest Niagara Engineer if you have a problem involving the industrial use of air.

NIAGARA BLOWER COMPANY

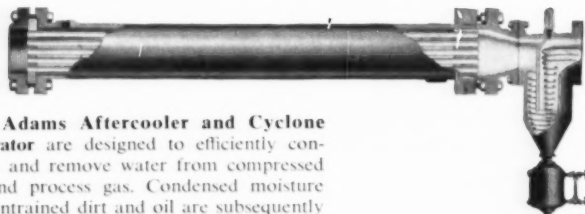
Dept. CA-9, 405 Lexington Ave., New York 17, N. Y.

Niagara District Engineers in Principal Cities of U. S. and Canada

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The Adams Aftercooler and Cyclone Separator are designed to efficiently condense and remove water from compressed air and process gas. Condensed moisture and entrained dirt and oil are subsequently removed in a cyclone type separator. This unit is scientifically designed for maximum removal efficiency over a wide range of flow rates.

For normal use, units are available to cool gases to within 10° F of the temperature of the cooling water. Specially designed units are available to permit a 2° F approach to cooling water temperature, for application where low moisture content is critical.

Adams Aftercoolers and Separators are available from stock to handle 20 - 40,000 cfm with 10° cooling and 25 - 19,200 cfm

where it is necessary to cool within 2° F of the cooling water. Special units can be supplied to suit an unlimited range of requirements. In all cases the maximum pressure loss at rated capacities is ½ psi.

This wide range of sizes enables the economical utilization of Adams Aftercoolers and Separators in virtually all industrial application. For further information on how R. P. Adams' units will solve your compressed air problems and save you money, write today for Bulletin 711.

paper thickness. Construction features include efficient muffling that reduces exhaust noise, special alloy steel gearing supported by oversized ball bearings, and a 3-jaw drill chuck designed to last the life of the drill. A dual-speed throttle enables the operator to start the drill at low speed, that insures accurate starting of holes, then obtain full sustained power for fast, smooth drilling. Powered with a 5-vane motor, the tool comes with either a straight lever throttle handle with suspension coil, or with a pistol grip handle. The pistol grip drills are equipped with an integral air strainer, lubricator and power regulator. Ingersoll-Rand Company, 11 Broadway, New York 4, N. Y.

A REVISED technical bulletin (L-171) has been published dealing with the use of disodium phosphate for low-cost boiler water treatment. In addition to chemical and physical descriptions of the compound, the bulletin describes methods of external and internal application of disodium phosphate to control scale formation in boilers. Copies of the booklet are available free. Monsanto Chemical Company, Inorganic Chemicals Division, 800 N. Lindbergh Boulevard, St. Louis 66, Mo.

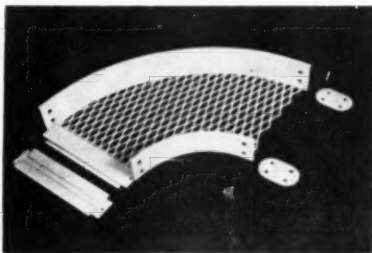
CLEVELAND VIBRATOR Company has announced production of a dual motor vibrator that is geared for synchronous action. Model RC1-31, as it is designated, produces straight line vibration in any direction. It operates on a rotating eccentric weight principle and features adjustable eccentrics, permitting the force of vibration to be varied without changing weights. There are four weights, two on each motor, contrarotating. Variable impact range is from 640 to 2200 pounds and any impact change can be made in a matter of minutes. Because there are no pulleys or belts within this totally enclosed vi-



brator, the operation is practically noiseless. Said to be ideal for heavy-duty applications requiring continuous flow of weighty bulk materials, the RC1-31

prevents sticking, arching or bridging. The unit, whose input is 1000 watts, is obtainable for 220-v, a-c, 3-phase, 60-cycle power. *Cleveland Vibrator Company, 2828 Clinton Avenue, Cleveland, Ohio.*

A CONTROL and power cable support system, the Chalfant 2SB Series, features a 9-11 gauge expanded mesh bottom that may be fabricated to any width necessary to support any number of cables. Lightweight mesh construction permits easier handling and reduces the need for large supporting structures. Increased ventilation properties of the mesh bottom are said to result in higher

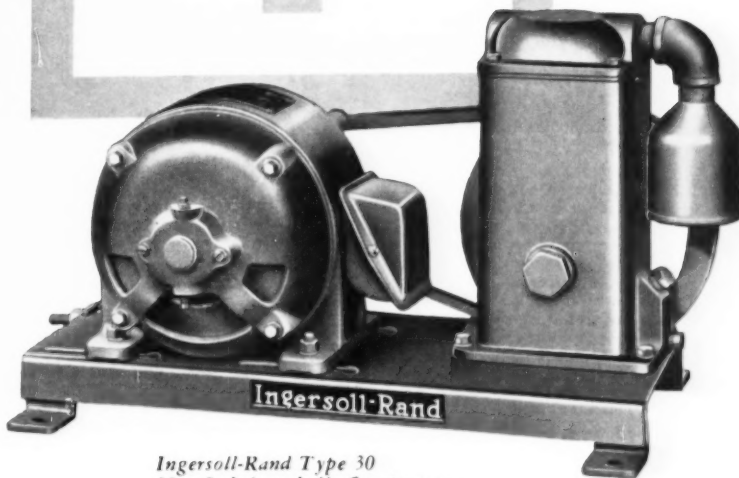


ampere ratings for the cables and reduce electrical losses throughout the cable support system because of the low permeability of the mesh. Inspection of cables is simplified. The collection of dirt, dust and moisture is minimized because foreign particles easily pass through the mesh openings. The cable supports are available in either aluminum or steel. *The Chalfant Products Company, Inc., 11525 Madison Avenue, Cleveland 2, Ohio.*

Study . . .

THE establishment of a fellowship to honor the visit of Her Majesty the Queen and His Royal Highness Prince Philip, Duke of Edinburgh, to the nickel mines in the Sudbury area of Ontario, has been announced by The International Nickel Company of Canada, Limited, and The Canada Council. (The Royal Couple went underground to view operations at Frood Mine, which the Queens' Royal Parents visited a little more than 20 years ago.) The fellowship being established will be called *The Queen Elizabeth II Fellowship (The International Nickel Company of Canada, Limited, Royal Tour, 1959)*, by gracious permission of the Queen, and its purpose is to enable a successful candidate to follow an original line of research in the earth sciences—chemistry or physics of metals, geophysics, geology, metallurgy, mineralogy or mining. It will be a post-doctoral fellowship tenable for 2 years. Inco has deposited with The Canada Council a total of \$15,000 and the Coun-

**clean,
oil-free
compressed air**



*Ingersoll-Rand Type 30
Non-Lubricated Air Compressors*

For applications requiring oil-free air, Ingersoll-Rand's Non-Lubricated Compressor is the economical answer. These I-R compressors are in wide use in dairies, breweries, distilleries, chemical and food plants.

These Non-Lubricated Compressors are designed with the compression cylinder separated from the crankcase by a cast-in wall and a special seal . . . available bare, baseplate or tank-mounted.

For complete data, write today.

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ADAMS

FACT FILE #2

PLANT AIR

Moisture Chief Cause of Trouble...

Every company today is looking for ways to offset the increased costs of labor, material, equipment and services. At a gasoline station you expect "Free Air", but in industry it is a major expense. Perhaps in your own plant, for an investment in a few minor compressed air system alterations, significant savings are possible.

Water, sludge, rust, oil and dirt in compressed air systems are prime causes of maintenance and production down-time. Water vapor condensing in air lines tends to corrode the piping. Also, water present in the piping may freeze during winter, causing serious reduction of compressed air supply. Such restrictions are often difficult to locate and thaw. This same line moisture may emulsify lube oil destroying its lubricating value and the resultant mixture has high fouling characteristics. Frequently, ice will form within the tool itself since expanding air cools the moisture... tool efficiency will be seriously affected.

Some of the Other Problems Created By Wet Compressed Air...

Wet compressed air is not only a construction and production tool problem. Faulty paint jobs, contaminated chemical and food products can often be traced to moisture laden compressed air. Water-hammer, unequal pipeline thermal expansion and line leaks also result from collected moisture. In addition, air lost through traps, and in blow-down of compressed air lines provide no useful work... represent a sizeable power loss.

You Can Lick Compressed Air Moisture Problem...

All of these hidden costs can be virtually eliminated by the installation of an Adams Aftercooler and Cyclone Separator between the compressor and receiver tank. By cooling discharge air to within 10° F. of cooling water temperature — guaranteed with Adams standard Aftercoolers — the moisture can be removed at the separator. Pressure loss is less than one-half pound on these units including the separator. In severe cases, moisture removal of over 90 per cent can be obtained by cooling the air with Adams 2° Aftercooler to within 2° F. of water temperature.

Air Filter for Final Protection at Point of Use...

As an added safeguard for expensive tools and equipment, an Adams Poro-Stone Air Filter should be installed just before the air is used. These filters remove all solid material picked up by the air stream. With an Adams Aftercooler, Cyclone Separator and Air Filters clean, dry, trouble-free air is supplied to your production tools. You get continuous service with minimum maintenance.

For further information on how the complete line of Adams air equipment can solve your compressed air problems, write today for your free copy of Bulletin No. 712 on Aftercoolers and Bulletin No. 117 on Poro-Stone Air Filters from the R. P. Adams Company, Inc., East Park Drive, Buffalo 17, New York.

cil will supervise all arrangements for the fellowship. (The Council was established by the Canadian government in 1957 for the encouragement of the arts, humanities and social sciences.) The selection of the fellow will be made by a special committee appointed by The National Conference of Canadian Universities & Colleges. The successful candidate will receive \$5000 a year for 2 years, and the Canadian university at which his research is to be carried on, \$2500 a year for 2 years. Candidates must hold a doctor's degree and will be required to give full time to the duties of the fellowship. Applications from Canadian citizens must be in the hands of the Council at 140 Wellington Street, Ottawa, Ont., by January 15. The award will be made on or about March 1, 1960.

Books...

Compilation of ASTM Standards On Steel Piping Materials A-1 (published by the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa.) is said to contain all the specifications for carbon-steel and alloy-steel pipe and tubing issued by the Society. Included are specifications on: pipe used to convey liquids, vapors and gases at normal and elevated temperatures; still tubes for refinery service; heat exchanger and condenser tubes; and boiler and superheater tubes. The volume contains specifications for castings, forgings, weldings, and bolts and nuts used in pipe and related installations. Of the 71 standards in the book, 49 have been revised recently or have had their status changed during the past year. This compilation replaces the March 1958 edition. Many of the specifications are incorporated in the ASME Boiler and Pressure Vessel Construction Code. 524 pages. Cost, \$6.

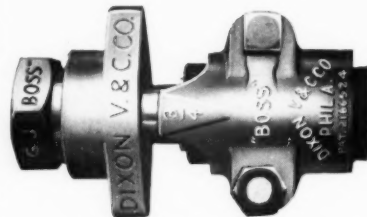
Unfired Pressure Vessels, Section VIII, ASME Boiler and Pressure Vessel Code (published by The American Society of Mechanical Engineers, 29 W. Thirty-ninth Street, New York 18, N. Y.) incorporates all changes that have been made in the code since 1956, the date of the last edition. Most of them have appeared during the last 3 years in the form of addenda to the code and are now an integral part of the text. The publication is divided into three sections of several parts each. There are five mandatory appendices of supplementary design formulas, definitions and charts; and sixteen nonmandatory appendices containing information about new materials, suggested good practices, examples illustrating the application of code rules, installation and operation. Copies may be obtained from the publisher's Order Department. Cost, \$6.

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The washerless coupling for all heavy-duty air hose connections to hand drills, wagon drills, drifters, jumbos. Famous for strength, durability and efficiency. Quickly connected and disconnected, with no lost or worn-out washers to replace. Compact and Heavy Types.

"BOSS" Air Hammer Coupling—same as above except Washer Type.

For lighter services—"GJ-Dixon" and "Dixon" Air Hammer Couplings.

"BOSS" Self-Honing AIR VALVES



Used for the efficient control of air on compressors, manifolds, headers, sump pumps, etc. Strong, durable, compact. Self-adjusting, quick-opening, full flow. Male or female I.P.T.

Bronze plug automatically hones to perfect seal against harder metal of valve body.

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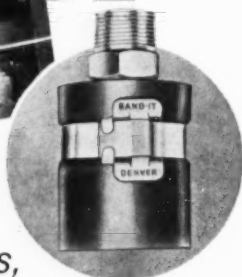
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Factory shipments of all four metals made to distributors in any quantity within 24 hours of receipt of order.

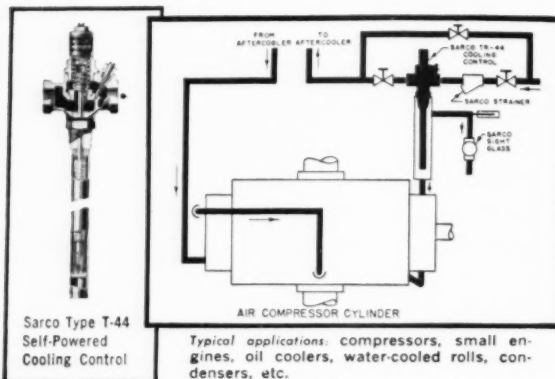
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Typical applications: compressors, small engines, oil coolers, water-cooled rolls, condensers, etc.

PROTECT COMPRESSORS against undercooling and overcooling

Undercooling cuts down compressor capacity . . . often damages cylinders, other parts.

Overcooling increases wear, destroys lubricants, wastes water.

You can avoid these troubles, step up the performance of your compressors, reduce maintenance, save water and lubricants. How? By replacing uncertain manual control of cooling water . . . by automatic

control with Sarco self-powered temperature regulators. Inexpensive. Simple. Require no outside power source. Packless. Easy to install by any pipefitter.

Write for Bulletin 710B. Sarco Co., Inc., 635 Madison Ave. New York 22, N. Y. 2229-F

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CAMERON PUMP OPERATORS' DATA:

Contains practical information covering the installation, operation and maintenance of centrifugal pumps.

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Covers data useful in work involving the handling of liquids, steam, and water vapors.

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in  heavy-duty

compressors

these **EXTRA-VALUE FEATURES**
mean top performance and economy



AIR-CUSHIONED CHANNEL VALVES

Highest efficiency • Exceptional
durability • Quiet operation



FULL-FLOATING ALUMINUM BEARINGS

Roll with the punch of
each stroke to distribute load



FULL FORCE-FEED LUBRICATION

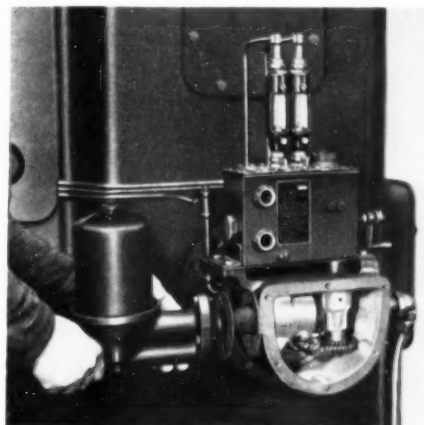
Filtered oil under pressure
to all bearing surfaces



SEALED FRAME

Keeps dirt out • Keeps oil in
Keeps wear down

◁ *take FULL FORCE-FEED
LUBRICATION for example...*



*a continuous flow of
filtered oil under pressure
to all bearing surfaces
without operator attention*

In Ingersoll-Rand heavy-duty compressors, running parts are continuously lubricated by filtered oil under pressure from a crankshaft-driven pump. All crankshafts and connecting rods have rifle-drilled oil passages, so internal lubrication piping is virtually eliminated. All systems have filters which keep the oil clean and free of impurities. Compressor cylinders receive special oil from separate systems.

This constant flow of oil over all working parts keeps wear to a minimum. In I-R compressors, since the frames are completely sealed, no dirt gets into the oil to cause wear; also, no oil gets out.

Full, filtered force-feed lubrication is only one of the quality features which have earned the Ingersoll-Rand heavy-duty compressor line its reputation for excellence. For more information on compressors of all types and sizes from 1/2 to 7500 hp, for pressures to 35,000 psi and vacuums, call your I-R representative today.



ESH
20 to 150 hp.



PHE
75 and 100 hp.



XLE
125 to 350 hp.



PRE
400 to 2000 hp.



XPV
(Steam-driven)
200 to 1500 hp.



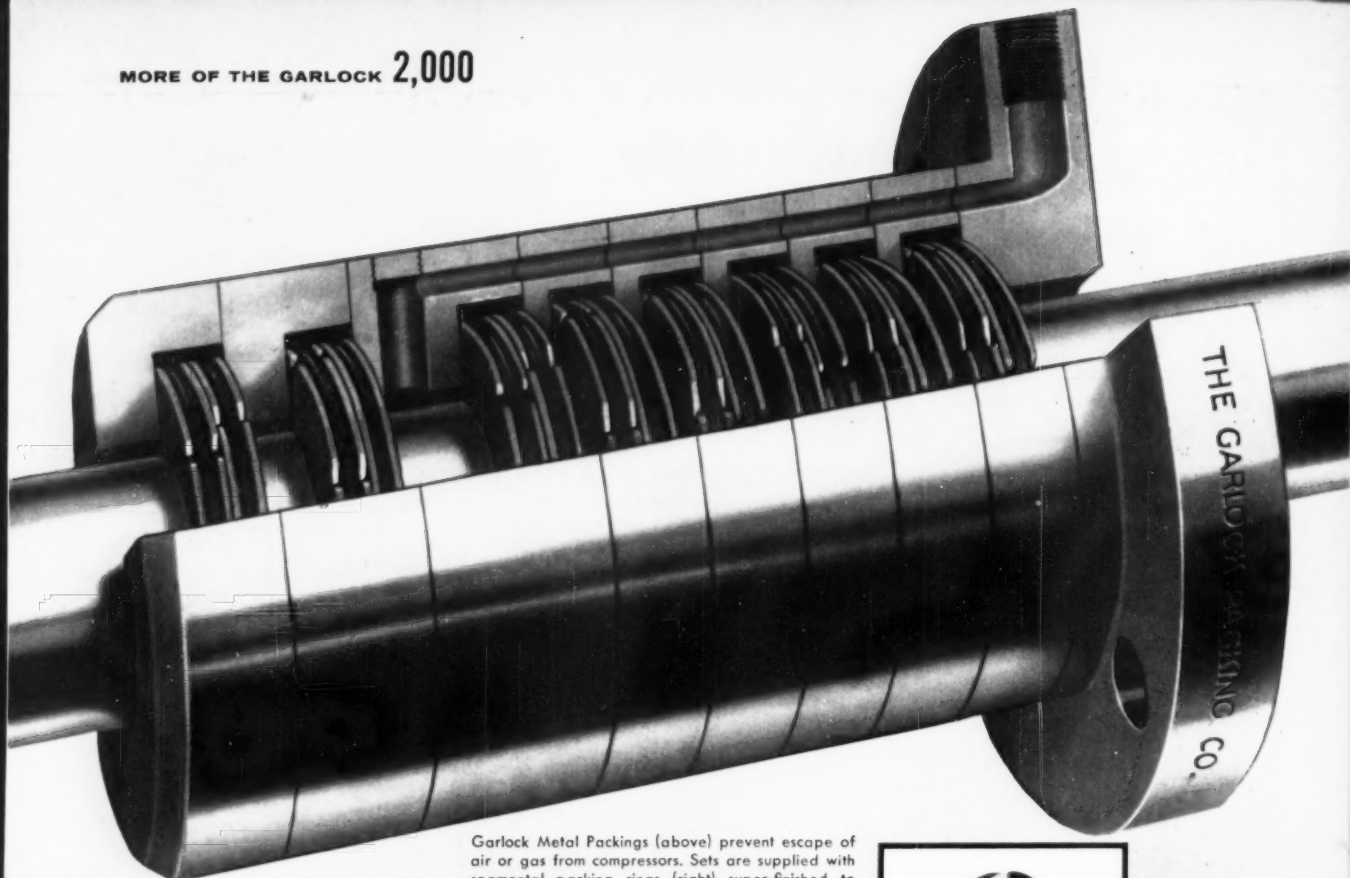
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MORE OF THE GARLOCK 2,000



Garlock Metal Packings (above) prevent escape of air or gas from compressors. Sets are supplied with segmental packing rings (right) super-finished to 15 micro-inches or less for better sealing.



Seal air and gas compressors this proven way... with Garlock Metal Packings

Every metal packing set that leaves the Garlock factory must meet the following rugged standards:

1. Gas tight seal between packing rings and compressor rod.
2. Gas tight seal between packing rings and packing groove.
3. Packing must not be affected by operating conditions.
4. Operating conditions must not be affected by packing.

5. Packing must have no adverse effect on compressor rod.

Get these fine features by specifying Garlock metal packings. Choose from many different styles and materials. Whichever you select, you can be sure of the finest metal packing available for air and gas compressor service.

Metal packings and oil scraper rings are more of the Garlock 2,000 . . . two thousand different styles of packings, gaskets, and seals for every need. Assure yourself of the proper application by discussing it with your local Garlock representative. Call him, or write

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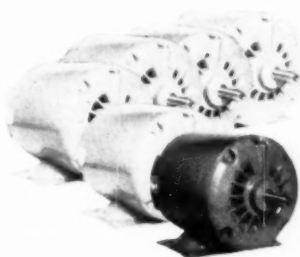
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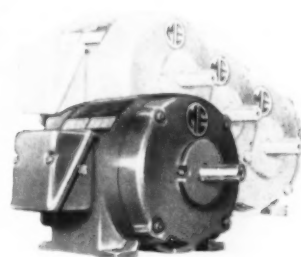
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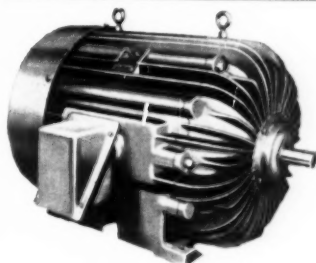
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General Purpose
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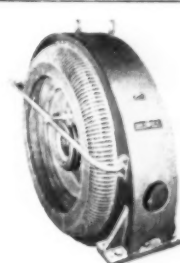
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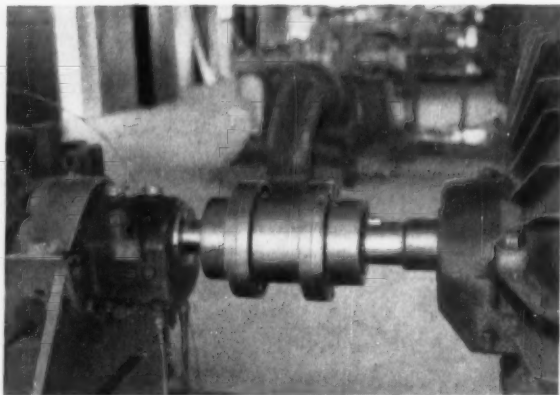
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WALDRON COUPLINGS....

**SAFEGUARD MACHINERY
NEED NO MAINTENANCE**



Waldron standard coupling on crude oil pumps on 20" line from Wyoming to Indiana.

John Waldron makes a complete line of standard couplings. They are all designed to transmit maximum power smoothly and safeguard the connected machines from the effects of misalignment which occur during operation. And, outside of periodic lubrication, the couplings never need maintenance. Hence, once these couplings are installed they will run continuously over the years (often outlasting the equipment they couple) with minimum care and maximum efficiency.

Waldron can stand behind these claims because their standard couplings are made of forged steel and are machined under controlled conditions. The two, one piece cover sleeves and spacer function as a single unit with no flexible metal parts to bend or break. Couplings are oil tight and dust and moisture free.

There are plenty of rough bore standard couplings on the shelves at Waldron and other locations throughout the country ready for immediate delivery. Finished bored couplings may be ordered to customer specifications.



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QUALITY
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**Specify
SQUARE D
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for GARAGE-TYPE AIR COMPRESSORS

- Easy wiring
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- Available with or without release valve
- Heavy-duty contacts, 2-pole, double break
- "Powerhouse" toggle spring for positive action at any differential
- Also explosion-resisting or water-tight enclosures

Write for Bulletin 9013 GHG, Square D Company,
4041 North Richards St., Milwaukee 12, Wisconsin



SQUARE D COMPANY

**The SNAP Makes
the Difference**

IN THIS AIR TRAP

**NO COSTLY AIR LEAKS
WITH THE
ARMSTRONG
SNAP-ACTION TRAP**



The spring-powered valve snaps wide open for fast drainage, snaps tightly closed before all water leaves trap—always a perfect water seal. No dribbling, no air loss. Snap-closing prevents fine grit from holding the valve away from the seat.

Trouble-free construction: the flat-strip spring of special Swedish steel lasts for years . . . valve and seat are hardened chrome steel. Cast semi-steel body for pressures to 250 lbs., forged steel for pressures to 1000 lbs.

SEND FOR HELPFUL BULLETIN

Bulletin 2024 tells how to select the right air trap for any job. Gives complete information on all Armstrong air traps for every service. To get your copy, just call your local Armstrong Representative, or write:

8855 Maple St., Three Rivers, Michigan

ARMSTRONG MACHINE WORKS

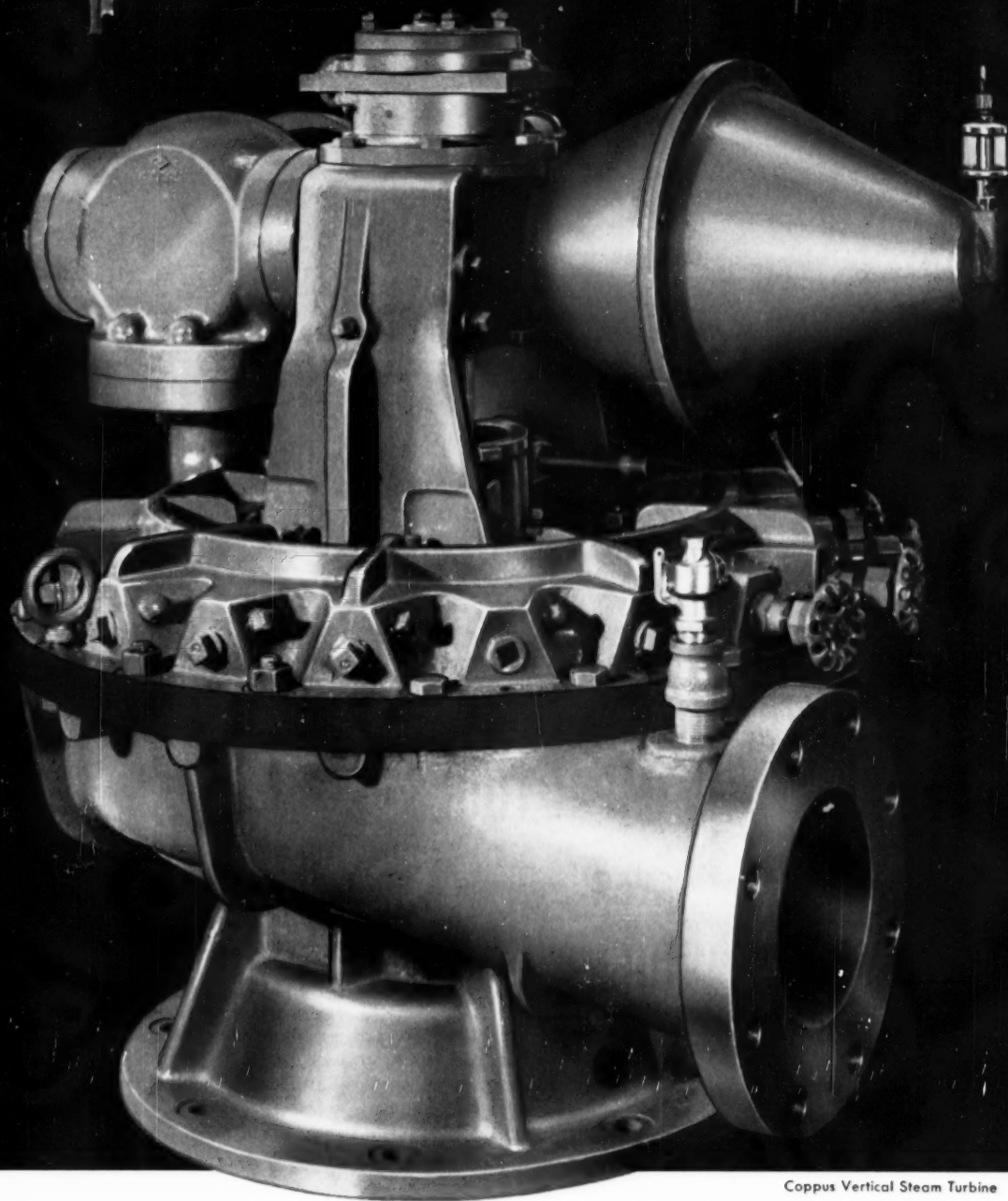


810-AT



COPPUS

BLUE RIBBON PRODUCTS



Coppus Vertical Steam Turbine

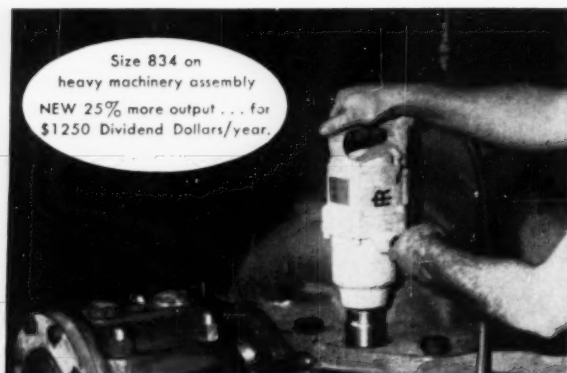
THE MARK OF QUALITY — There's no better test of a turbine's quality than performance. And the new, ruggedly designed, power-packed Coppus Turbines pass all performance tests with top honors! Small wonder. Coppus quality is literally designed and built into them. Their super stamina is the end-product of painstaking craftsmanship, finest materials and methods, thorough testing and control. Each truly deserves its Blue Ribbon . . . assurance of *complete* reliability.

Typical Coppus Blue Ribbon features are: *totally enclosed governor . . . totally enclosed and independently operated safety trip . . . easily replaceable packing and bearings . . . multiple steam nozzle control . . . brake rim for added safety . . . wide bucket "L" type wheel (optional)*

for minimum water rate. You get higher efficiency operation . . . less down time . . . lower maintenance costs.

Coppus Turbines are built to customers' specifications, including API and NEMA standards. Send for Catalog 200. Get complete details on Coppus Turbines. Sizes from 1 HP to 250 HP. Write COPPUS ENGINEERING CORPORATION, 209 Park Avenue, Worcester, Mass. Sales Offices in *Thomas' Register*.

COPPUS
STEAM TURBINES



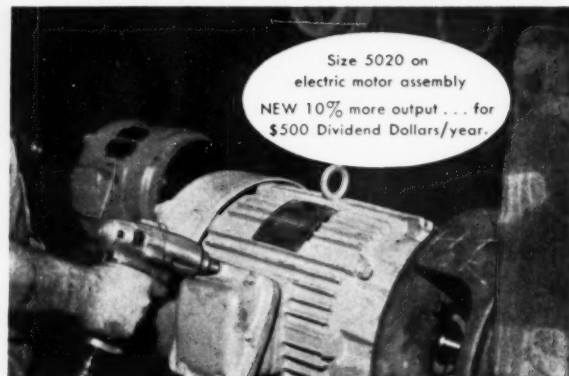
Size 834 on
heavy machinery assembly
NEW 25% more output ... for
\$1250 Dividend Dollars/year.



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NEW 40% more output ... for
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NEW 10% more output ... for
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4 NEW IMPACTTOOLS

NEW designs

NEW speeds

NEW power to give you an

ANNUAL DIVIDEND on your PAYROLL DOLLARS

If your operators are using older model Impacttools, you can increase their man-hour productivity by as much as \$2000 Payroll Dollars in one year, just by replacing the older tools with one of the 4 new I-R designs.

Multiply these *Annual Dividends* by the number of Impacttool operators in your plant, and you can see why management today is taking a new look at portable tool operations.

There's a fast, easy way to calculate the amount of *Dividend on Payroll Dollars* these new I-R Impacttools can help you earn in just one year—without adding to your present payroll.

It's yours without obligation. To get it, call your I-R AIRengineer today. Or write Ingersoll-Rand, 11 Broadway, New York 4, N. Y. 8-920



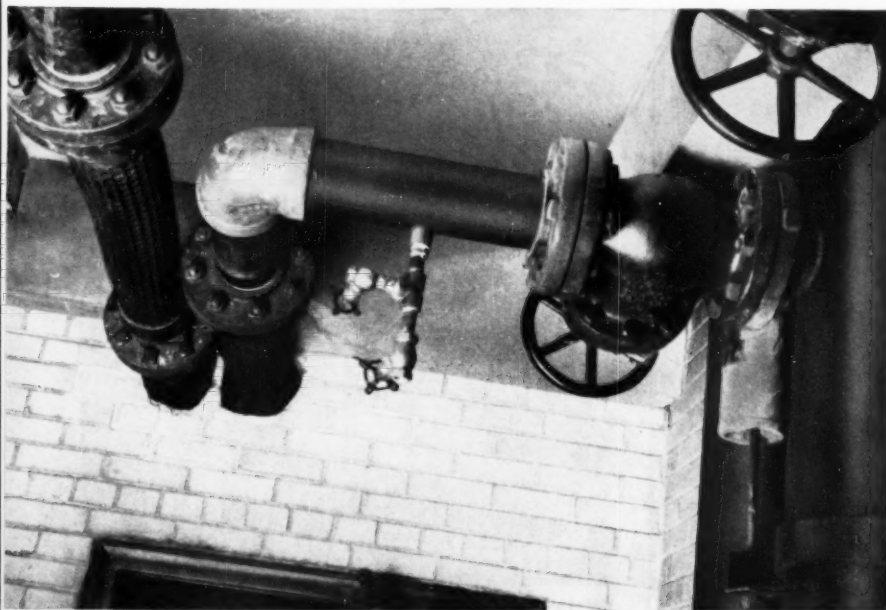
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Tools plus AIRengineering
increase output per man

APPLICATION HINTS:

Ways to simplify construction and cut costs with *Flexpipe*



Flexpipe helps meet tough piping problem in air conditioning an existing building

THE PROBLEM: Air conditioning an existing office building usually calls for a bit of ingenuity in design. One large New York office building decided to air condition by making provision for packaged, water-cooled units to be installed on any floor as tenants required.

This called for four 10-inch risers, running the height of the building, to carry cooling water between the cooling tower and the branch pipes at each floor level. Because of structural conditions, the risers could not be run down through the basements and supported from below. The combined weight of pipes and the water was so great that they could not be anchored at any one point on the structure.

So the consulting engineers, Zimmermann Engineering, New York, floated the risers on spring hangers, distributing the

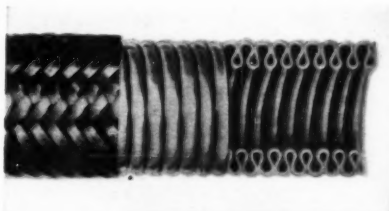
weight evenly over all floors. This meant, however, that the risers were free to move. A riser full of water weighs several tons more than an empty one and settles about two inches.

Therefore connections between risers and branch pipes had to be flexible. They also had to have strength, because water pressure at the lower floors approaches 400 psi.

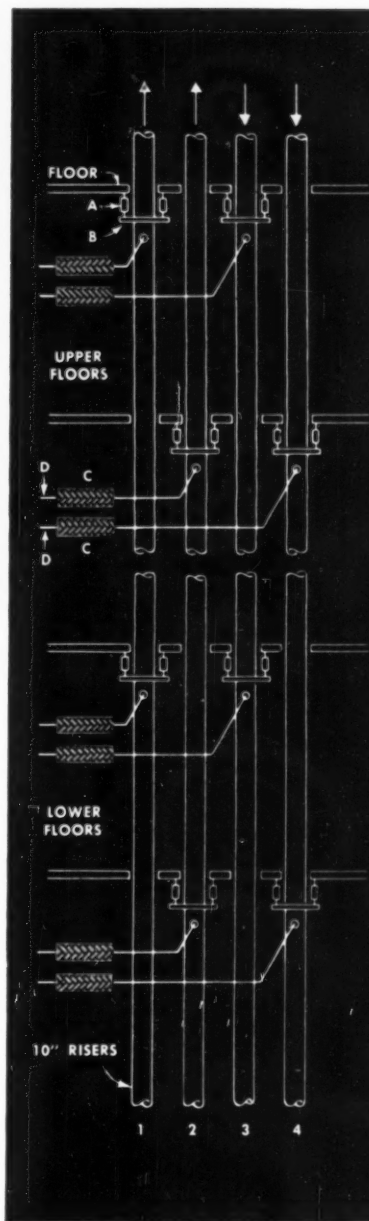
THE SOLUTION: Flexpipe connectors were the answer. They provided the flexibility and the strength required. Furthermore, they were available in the sizes needed—from 5" diameter at the lower floors to 2" at the top floors.

WHERE TO BUY: Flexpipe connectors come in convenient standard sizes and are sold by leading distributors. They can show you samples and answer questions about service applications. For the name and address of the one serving your area, or for more detailed information, write to: Anaconda Metal Hose Division, The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Limited, New Toronto, Ont.

38226 Rev.



FLEXPIPE'S flexible core can be either tin bronze, hot dipped galvanized steel or stainless steel. End fittings (attached): flanges, threaded males and welding nipples.



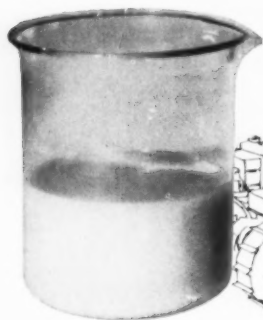
SCHEMATIC DIAGRAM showing how cooling-water risers were installed. A: spring hangers. B: pipe clamps. C: Flexpipes. D: branch pipes at each floor. 1, 2, 3, and 4: risers, 10 inches in diameter. Upper left: Photo of Flexpipe installation at a lower floor.

Flexpipe® an **ANACONDA**® product

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**Ordinary oil
separates from water**



NON-FLUID OIL

emulsifies with water

Ordinary oil separates from air-borne moisture* leaving air tools open to rust and corrosion. Result: a loss of power and efficiency. NON-FLUID OIL is compatible with moisture and keeps air tools protected.

The NR grades of NON-FLUID OIL work on the principle "if you can't lick moisture, join it." The NR grades are engineered to emulsify permanently with air-borne moisture. They go right along with the moisture and protect working surfaces from sticking, gumming, rusting.

That's why pneumatic tool manufacturers use and recommend the NR grades of NON-FLUID OIL for their equipment, and why they are employed by hundreds of the larger users of air tools. Write for free testing sample and bulletin No. 550. See for yourself.

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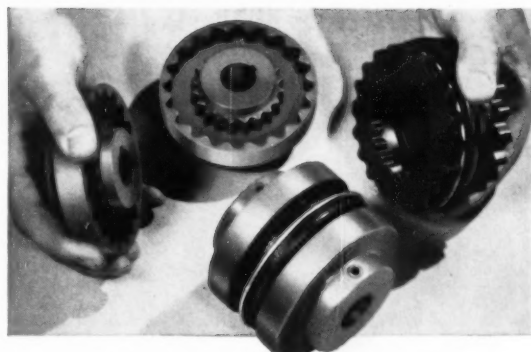
The Air Trap is automatic and eliminates manual draining.

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Air-Maze Corporation	37	Hansen Manufacturing Company, The	5
Allen-Bradley Company	2nd Cover	Ingersoll-Rand Company 4, 39, 43, 48, Back Cover	
Anaconda Company, The	49	Koppers Company	7
Armstrong Machine Works	46	Marathon Electric	45
Band-It Company	42	M-B Products	51
Bearium Metals Corporation	36	Nayler Pipe Company	2
Bethlehem Steel Company	8	New Jersey Meter Co., Inc.	36
Bucyrus-Erie Company	41	N. Y. & N. J. Lubricant Co.	50
Celanese Corporation of Air-Chemical Division	9	Niagara Blower Company	38
Commercial Filters Corporation	52	Punch-Lok Company	50
Compressed Air Magazine Company	42	Sarco Co., Inc.	42
Conrader Co., Inc. R.	35	A. Schrader's Son-Division Scovill Mfg. Co., Inc.	3rd Cover
Coppus Engineering Corporation	47	Square D Company	46
Dixon Valve & Coupling Company	40	Waldron Corporation, John—Subsidiary of Midland-Ross Corp.	46
Dollinger Corporation	1	Wood's Sons Company, T. B.	51
Eimco Corporation, The	6		
Editorial Index		Page 3	

ECONOMICAL...



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The BA Models (illustrated) are made in three sizes — for 3", 5" and 7" Honeycomb Filter Tubes. Maximum flow rate is 150 scfm at 125 psi, through a 7" element, with an initial pressure loss of only 3 psi. Metal baffle deflects oil and moisture to sump. Positive seal at top and bottom prevents by-passing.

Other single-tube Fulflo Filters are available for operating pressures up to 250, 450, 750 or 4,000 psi. Multi-tube models are designed for operating pressures to 150 psi. Pipe sizes range from 1½" NPT to 6" NPT.

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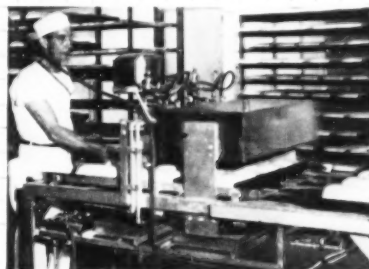
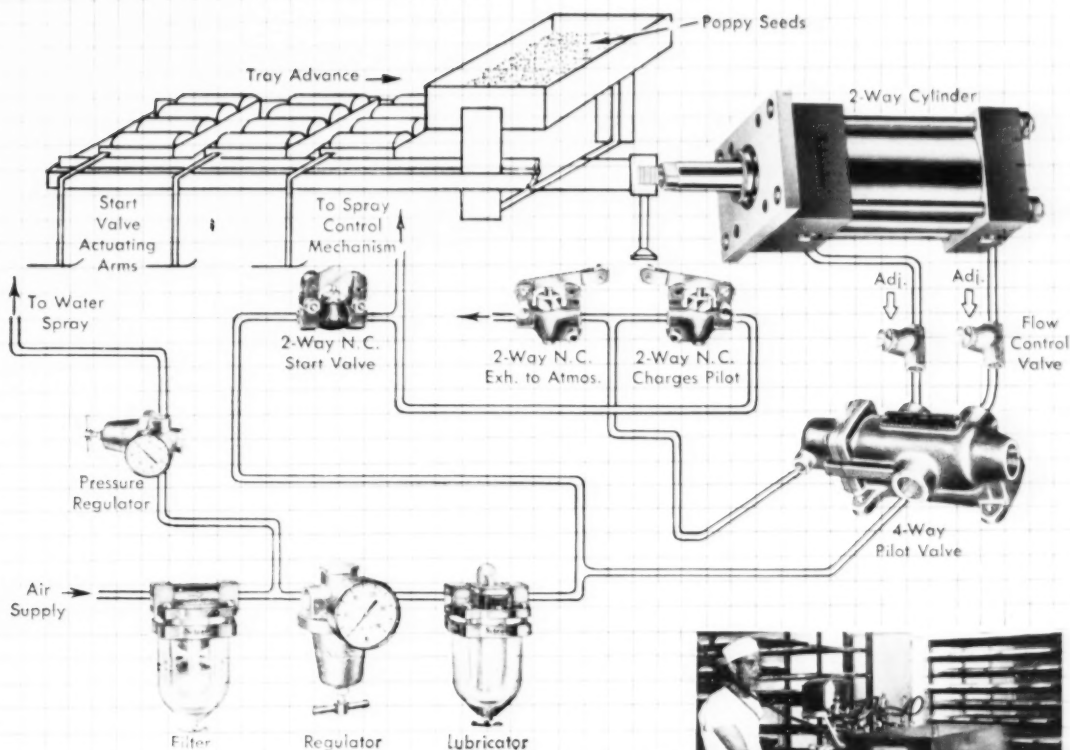


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These are benefits every shop needs. Get them all when you automate with Schrader . . . the finest line of Air Cylinders, Valves and Accessories . . . and ideas for cutting your operating costs.

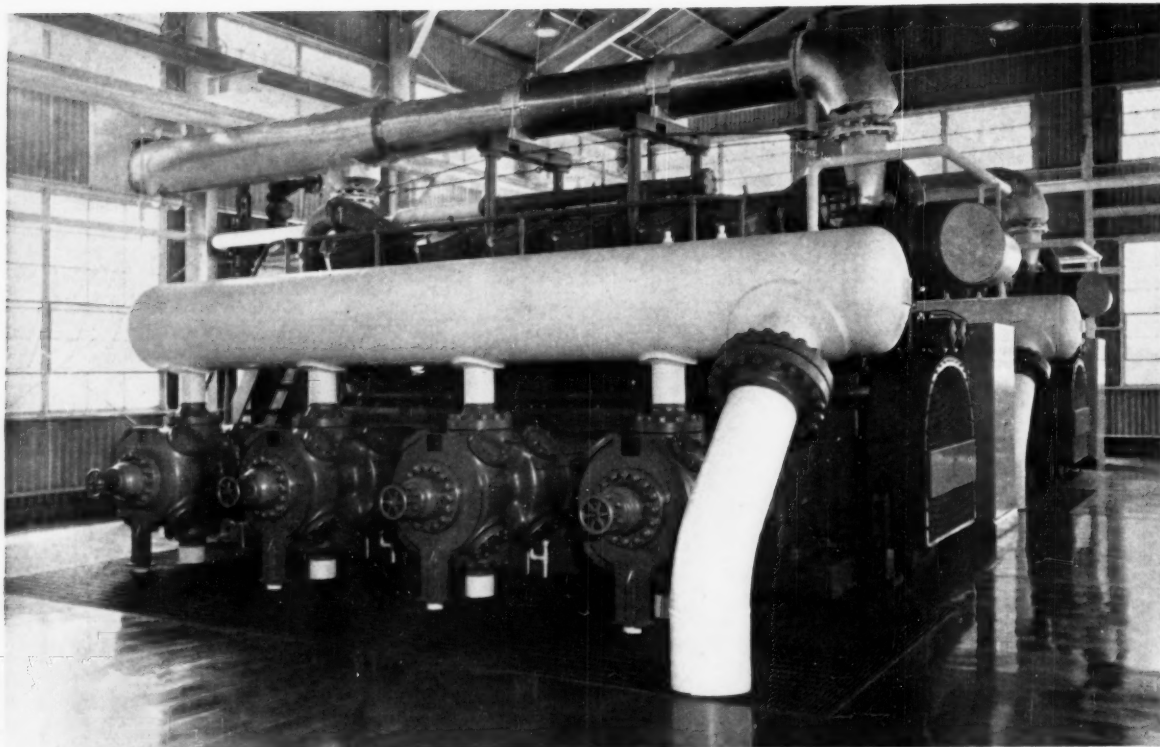
Here's a typical example of how companies can automate with air. The hookup of Schrader Air Products in the large picture was used to perform repetitive operations by General Baking Company, Detroit, Michigan. A tray of loaves moving on a belt trips a Schrader 2-way valve which actuates the water spray mechanism—and starts the 4-way valve-operated reciprocating system. The 4-way valve operates the cylinder which sifts poppy seeds onto each loaf in turn. This was formerly repetitive hand work. Schrader representatives helped plan this effective air system, as they have helped plan innumerable others.

Use the full Schrader line to do your air control selecting. Your Schrader distributor can help you pinpoint what you need. For more data write:

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QUALITY AIR CONTROL PRODUCTS



which comes first...

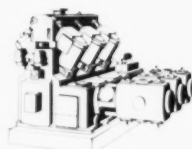
the **ENGINE** or the **COMPRESSOR**?

Of course, the power end of a gas-engine compressor is important. The engine cylinders must be capable of delivering smooth power in continuous operation, month after month, with efficiency and economy. And no engine can show better records of long run reliability and sustained efficiency than the Ingersoll-Rand 4-cycle V-angle design. The smooth running characteristics of the I-R 4-cycle engine are well-known.

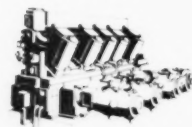
But don't forget the compressor end; after all, that's what you've really bought—a compressor! The sustained compression efficiency and freedom from maintenance troubles are what make the difference. Ingersoll-Rand has the world's most comprehensive compressor experience, and builds the

widest line of units to suit the exact requirements of any application.

One of the major differences between I-R and other compressors is the valving. I-R Channel Valves are known around the world for efficiency, quietness, and almost unbelievable durability. Each valve is a combination of rigid stainless-steel channels and bowed leaf springs, with trapped-air spaces which cushion action and prevent impact. The separate stainless-steel seat plate can be reversed for double life or replaced, using only simple tools; the I-R Channel Valve is the only compressor valve that can be completely reconditioned in the field without machining. And only Ingersoll-Rand compressors have genuine Channel Valves.



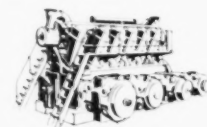
JVG 120 240 hp



SVG 330 660 hp



KVG 660 1320 hp



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